WORLD CROPS

THEIR CULTIVATION, PROTECTION, STORAGE, HANDLING AND PROCESSING FOR FOOD, FODDER, AND INDUSTRIAL PRODUCTS

VOLUME 2, NO. 3 MARCH 1950

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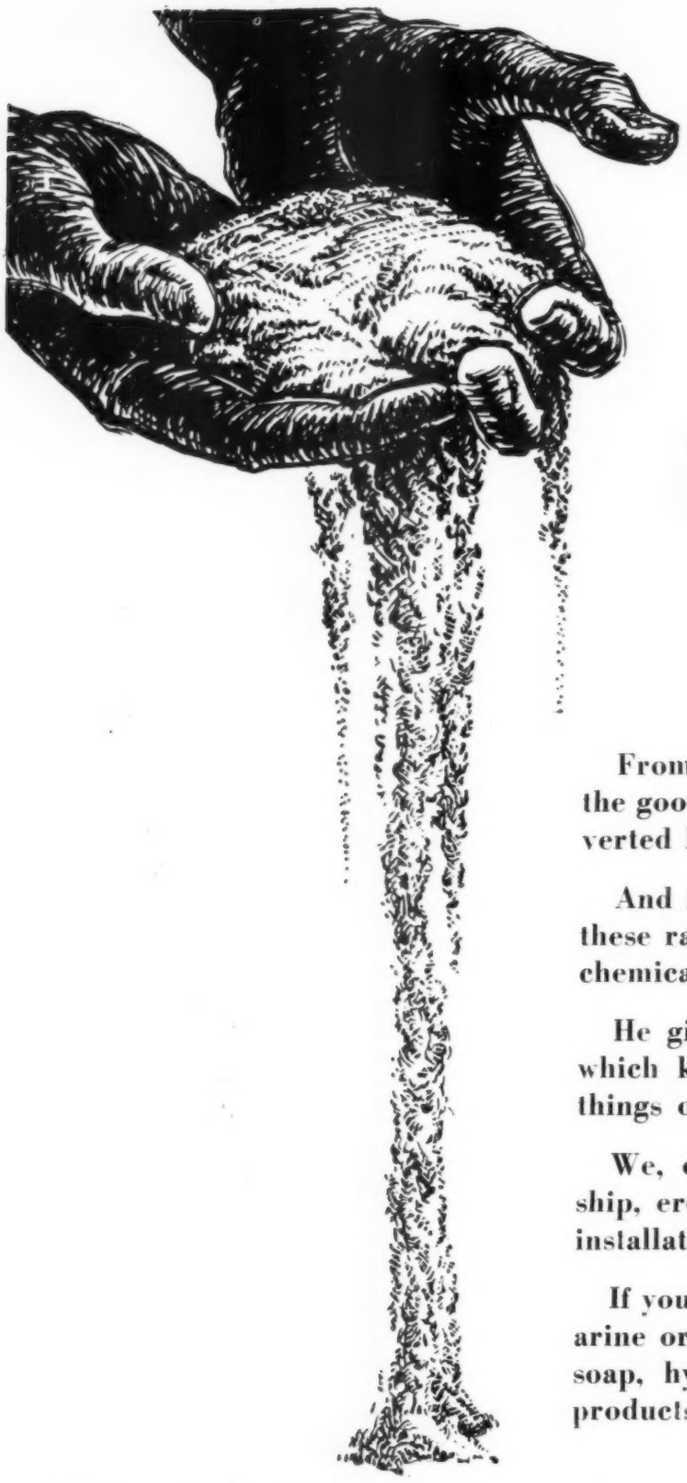

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WORLD CROPS

Editor: Sir Harold A. Tempany, C.M.G., C.B.E., D.SC., F.R.I.C.

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THIS MONTH'S COVER

A scene of beauty and grandeur. This photo of a tea garden was taken in Upper Assam on the edge of the Himalayan Mountains. The tea bushes are in leaf and soon the pickers will be moving slowly across the terraces, stripping off the leaves.

(Photo.: Courtesy of The Tea Bureau, London.)

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Editorial Comment

British agricultural policy

VERY shortly after this issue of WORLD CROPS appears the British General Election will be over and the world will know which party will be responsible for the government of this country during the next four years.

The election is likely to be hotly contested, but it is remarkable that as far as agriculture is concerned there is comparatively little disagreement between the Socialists and the Conservatives about the broad lines such a policy must follow. The present position, in fact, is largely the outcome of the policy laid down by the Coalition Government during the war.

In regard to home agriculture all are agreed that production must be further increased and the nearest possible approximation to self-sufficiency in food supplies achieved. It is also agreed that, while the country can never become completely self-sufficient, the achievement of 60% or even possibly 70% production of the nation's food at home is by no means impossible. There is also agreement that a measure of price support for home-grown produce is necessary, combined with a considerable degree of control over farming operations, while the need for provision to assist agriculture both by research and through the National Advisory Services is fully accepted by both sides.

There is similar unanimity concerning colonial agricultural policy. Apart from the spectacular venture of the Ministry of Food into the field of agriculture in East Africa, which has been severely criticised, there is general agreement on the policy of assisting colonial agricultural development, and few would deny that, despite differences of opinion in regard to detail, the Colonial Office, under Mr. Creech Jones, has made noteworthy contributions to the solution of the many problems in agriculture and agricultural economics which at present beset the colonies.

In fact, despite party differences there has been a considerable measure of continuity between the colonial agriculture policy of the Socialists and that of their predecessors.

The fundamental issue at stake both in home and colonial agriculture is whether future development along generally agreed lines shall be pursued by methods which tend to concentrate all executive power at the centre and to bring increasingly all agricultural operations under government control, or whether the desired ends may not be better accomplished by relaxing controls to the full and giving as much latitude as possible to the producer in the management of his affairs. All parties will agree that in the present juncture of world affairs increasing regulation of land use and production is imperative in the public interest; what is controversial is really the amount of regulation which is necessary and desirable and the best means of securing it.

The result of the election will decide the issue not only for the next five years but probably for a very much longer period.

Commonwealth sugar

ONE might think that the agreeable and stimulating properties of sugar would somewhat sweeten discussions on its production and distribution. Unfortunately this is far from the case and almost from time immemorial sugar has provoked disputes and divergences of view, probably more so than any other staple.

The recent discussions between the British Government and representatives of the Commonwealth sugar-producing countries have proved no exception to previous experience, since the talks have ended with dissatisfaction on the part of at least some of the Colonial sugar producers with the proposals put forward by the U.K. Details of the proposals have since been issued and these clarify the position.

The arrangement whereby the British Government undertakes to find an outlet for all Commonwealth sugar terminates in 1952, while the special arrangement whereby supplies of sugar to Canada were arranged through the Sugar Control terminated in 1949, the Canadian refiners being now free to buy their sugar where they can get it most cheaply. It seems likely that between now and 1952 the other sugar-importing Dominions, *i.e.* New Zealand and Ceylon, may also wish to purchase their own sugar in their own way.

In these circumstances it is announced that the British Government will continue to purchase the whole exportable surplus of the sugar-producing Commonwealth countries until 1952 under the existing contract, while from 1953 till 1958 they will guarantee a market in the United Kingdom for a total of 1,550,000 tons, of which 1,100,000 tons will come from the Colonies and 450,000 tons from South Africa and Australia. The Government further suggests that Commonwealth countries should not expand their exportable production beyond a maximum of 2,350,000 tons during the same period, of which 1,550,000 tons would be contributed by the Colonies. The balance of the Colonial production not covered by the guarantee should, it is considered, readily find a market either in the United Kingdom or Canada.

The price for the 1950 crop has been fixed at 12% above that of the 1949 crop, while in fixing

prices in subsequent years reasonable further increases in the cost of production and other relevant factors will be taken into consideration.

The proposals have been accepted by Mauritius but not, up to the time of writing, by the West Indian colonies, the grounds for dissatisfaction apparently being the smallness of the guaranteed quota and the uncertainty regarding the prices likely to be offered.

Growing populations, setbacks and difficulties in regard to other agricultural industries in the West Indies, notably cocoa and bananas, have increased the importance of sugar to these countries. Moreover, agricultural improvements, notably the production of high-yielding cane varieties, have enabled ever-increasing returns to be obtained from the areas cultivated. On the other hand, it seems inescapable that a guaranteed market for the bulk of the production, with the added advantage of protected markets for the balance of the production within the prescribed limits, are solid benefits which cannot lightly be disregarded.

It is to be hoped that before long the differences will be adjusted and a solution reached, since the proposal for a definite long-term contract over a term of years does in itself represent a substantial advance towards achieving a considerable measure of price stabilisation for a product and an industry which in the past have suffered more than most from the curse of wildly fluctuating world prices.

Fertilisers in the British Colonies

DECLINING soil fertility in parts of the British colonial dependencies, especially on small peasant holdings throughout tropical Africa, is an increasingly serious problem. Rapid increases in population are leading to the breakdown of traditional shifting cultivation, which relies on prolonged bush fallows to maintain fertility. These periods have in many cases become shortened or even eliminated and in the absence of manuring and adequate protection from erosion the position is serious.

Information about the use of manures and fertilisers under colonial conditions is still relatively meagre and is mostly confined to a few plantation crops, notably sugar, tea and rubber. Little is known about the requirements of many other crops, notably food crops, while many aspects of the action of fertilisers under tropical conditions are still obscure.

The need for further work has been repeatedly stressed by the Colonial Soils and Fertilisers Sub-Committee and was strongly urged by the Tropical Soils Conference which met at Rothamsted in 1948. To supply the information needed, colonial research staffs have been or are being strengthened, and an adviser on tropical soils has been attached to the staff of Rothamsted Experimental Station in the person of Dr. H. Green.

In East Africa, where the position is particularly serious, a team of officers was organised in 1947 to carry out extensive experiments under the guidance of the East African Agricultural and Forestry Research Organisation.

Last July the question was discussed at a conference of technical officers from the East African dependencies and the Belgian Congo, the findings of which were recently reviewed in the *East African Agricultural Journal*.

The main point that emerged was the very variable response to fertilisers, and although dressings of nitrogen, phosphoric acid and potash gave increased yields in some cases, the responses were not consistent, an unexpected result since the natural fertility of East African soils is not high. Clearly there are factors which confuse the issue, rainfall being the most obvious. It may well be that in the drier parts no response to fertilisers can be expected except in years of very favourable rainfall, and the issue may hinge upon devising methods of increasing the moisture-retaining capacity of the soil, thus making the fullest use of available rain. This problem is intimately bound up with soil structure which, in turn, depends upon soil organic matter. On this account alone it would appear that the elucidation of the role of organic matter in these soils calls for early and intensive study.

In the Lake Province of Tanganyika organic manures have given very striking results and residual effects have been observed up to the fifth year after application. The results have not been duplicated elsewhere and it may be that the effect is caused, at any rate in part, by deficiency of one of more of the essential trace elements. This, however, does not alter the vital need for investigation of the part organic matter plays in maintaining fertility, not only in its relation to soil structure but also in connection with its biological processes; about these too little is known; they may pursue quite different courses under fully tropical conditions. To us it seems that the tendency to view fertility primarily in terms of mineral relationships and to relegate the role of organic matter to a secondary place may be just as much a mistake in emphasis as the tendency of the ultra-organic school to interpret everything in terms of soil organic matter. It is interesting to note here that Dr. J. E. A. den Doop has suggested that small doses of organic matter may act as ' triggers ' in stimulating microbiological activity.

It may be that elimination of phosphate deficiency is one of the keys to raising the fertility of East African soils, in which event the large deposits of phosphates at Tororo in Uganda and at Zizi in the southern provinces of Tanganyika represent assets

of great potential importance. On the other hand, results so far indicate that no spectacular increase can be expected from applications of ground phosphate rock or soda phosphate prepared from it; even superphosphate has led to only small responses except on very impoverished soils, while placement has not given conclusively favourable results. It has been suggested that continuous broadcast application of rock phosphate may, by slowly building up reserves in the soil, lead eventually to satisfactory yield increases.

Observations in Uganda which have shown that nitrates can accumulate in top soils in amounts equivalent to 400 lb. of sulphate of ammonia per acre during fallow period may explain the inconsistency of results obtained with nitrogenous fertilisers. Here again this seems to point to the need for intensive research on the microbiological processes, especially applied to the nitrogen cycle. Incidentally, free-living nitrogen-fixing bacteria do not appear to have received much attention in this connection hitherto; in fact, they may be not unimportant. These aspects are also intimately connected with the role of organic matter in the soil.

If nitrogenous fertilisers are likely to be extensively required, the harnessing of the Owen Falls to produce electric energy may make possible the manufacture of synthetic nitrogenous fertilisers as well as the processing of the naturally-occurring phosphate deposits, but the expense involved can only be justified in the light of unequivocal evidence of the effectiveness of these elements.

The problem of increasing the fertility of East African soils is clearly one of considerable complexity. It is equally clear that means must be found to increase crop returns, particularly food crops, especially in native areas. With modern methods of field experimental techniques, results can be obtained more quickly, but the problems are unlikely to be resolved effectively unless field work is accompanied by intensive research on the processes which go on in the soil, since it is only in the light of such information that the existing discrepancies may be explained and the present empiricism of manurial application replaced by a scientifically proved rationale.

Crops and water

IN the present issue we publish two papers dealing with the utilisation of water by crops, one by Dr. Walter Russell discusses some of the theoretical considerations underlying the question from the point of view of the plant physiologist and the other by Mr. John Grindrod describes developments in progress in Egypt to increase the amount of irrigation water available to cultivators in the Nile Valley. There is no doubt that the extension of irrigation is one of the most effective means at the disposal of man for increasing agricultural production, but hitherto attention has been concentrated upon water storage, it has been usual to regard the matter from an engineering point of view and to assume that once means have been devised for storing supplies of water and distributing them to cultivators all that is necessary has been done.

In actual fact it is not only necessary to provide supplies of irrigation water, it is equally important to ensure that they are used by the cultivator with due regard to efficiency and economy, since obviously the more economical the use of water the greater will be the benefit derived.

It seems clear that this aspect requires urgent attention and that research directed not only to the water requirements of crops but also to the losses entailed in applying it to the land can, if the lessons are intelligently applied, lead to almost as great gains as those derived from making additional water supplies available.

The historical approach

IT sounds a somewhat sententious aphorism to remark that the present is the child of the past, but with the ever-accelerating tempo of agricultural development and the growing spate of new ideas and discoveries which jostle one another for attention by the farmer, the lessons to be drawn from the past may at times escape attention. Agriculture the world over is passing through a revolution which far transcends anything which has occurred in the past; the growing needs of increasing world populations and the urgent necessity for increasing output per head of labour employed have been the stimuli for this revolution while the vastly increased resources of applied science and engineering have made it possible.

Nevertheless, too often the attention of the research worker has been confined within the narrow limits of his own particular problem, and while he is willing and anxious to scrutinise with the utmost care the results obtained by other workers in his own field, there has often been a curious reluctance to inform himself of and to profit by the experience of previous generations of cultivators, devoid, it is true, of the scientific approach, but, nevertheless, representing an accumulation of practical knowledge of great value and providing the basis for existing practices.

For these reasons, works that review the histories of agriculture in particular environments or in relation to particular crops have great value. A classic example, of course, is Lord Ernle's *British Farming Past and Present*.

We are impelled to these reflections by two books, one from the pen of Mr. Noel Deer, called *The History of Sugar*,* the first volume of which, dealing

**The History of Sugar*, Vol. I. By Noel Deer. Chapman and Hall, London, 1950, price 50s.

with the cane sugar industry, has just been published; the other, by the Swedish authority, Mr. Ivar Erneholm, dealing with the history of cacao production in South America.* It is not our intention to review these books here; that we shall do in a later issue, but we mention them because they exemplify the point we have in mind and provide information as to the way in which the industries came into being, the progress they have made and the difficulties, economic and cultural, with which they have from time to time been confronted.

In certain of the Australian agricultural journals also, there have appeared recently accounts of the history of agricultural development in some of the states of the Commonwealth, and these too are valuable additions to the literature.

The formidable and ever-growing volume of literature on agricultural topics makes one chary of suggesting further additions, but on the other hand, the value of such historical compilations is so great that we hope the examples we have quoted may lead in due course to similar historical reviews of other aspects of world agriculture.

**The History of Cocoa in S. American Countries.* By Ivar Erneholm. Published in Sweden (English translation).

F.A.O.'s fifth session

THE opening of the fifth session of F.A.O. in Washington on November last was probably an event of more than ordinary importance in its history. The inaugural address of the new Director General, Mr. Norris E. Dodd, set the tone for the meeting; couched as it was on severely practical lines, it combined a brief outline of the world agricultural situation and the problems requiring to be faced with a sober appreciation of the limits imposed upon the powers and activities of F.A.O. by the terms of its constitution and the resources available to it.

Such a review was timely for it is all too easy in these days, when the whole world bristles with urgent problems, for assemblies to be led into a region where eyes are dazzled by splendid visions and judgments obscured by the overwhelming magnificence of plans submitted to them.

As Mr. Dodd pointed out, F.A.O. can, within the limits of its resources, assemble facts and figures, it can prepare plans and schemes, it can furnish technical advice and assistance and it can help member governments to carry out programmes and recommendations; but the power to decide and to act in regard to their acceptance and implementation resides with the member governments themselves. If governments are willing to act together a beginning can be made, but if they are not, the fact should be recognised.

Moreover, technical and advisory services are all that F.A.O. has to offer; to translate these into practical and effective action requires in many countries the strengthening or creation of national services to reach the farmers and cultivators themselves. F.A.O. cannot create them, however—they must originate within the countries themselves—although F.A.O. can help with advice as to the form they can appropriately take.

In short, the role of F.A.O. is to act as a repository of information, to provide guidance and advice, to formulate plans and proposals and to act as the guide, philosopher and friend of the member nations in matters relating to agriculture and food production, to which they will automatically turn for guidance and help in solving their own problems. It can, moreover, act as a co-ordinator and assist in securing a unified international approach to matters of common interest.

Such a role is difficult, but it is of vast potential importance. It requires that the value and the standing of the organisation should be accepted by all and that the resources which it can command are sufficient for the ends in view.

Already F.A.O. has given proof of its utility in a number of directions, its work on the problem of rice supplies in the Far Eastern region being an example. It is certainly a high tribute that the Economic and Social Council of U.N.O. should have recommended that the largest share of funds available should be allocated to the field of food and agriculture. Let us hope that the present promise will in due time achieve complete fulfilment and that ultimately the activities of F.A.O. may be extended to include every country in the world within its membership.

The Society of Chemical Industry

WE welcome the new *Journal of the Science of Food and Agriculture* published by the Society of Chemical Industry, the first number of which appeared last month. The journal is intended, primarily, to provide a means for the publication of research papers on the chemical aspects of these two closely related subjects, but the inclusion from time to time of papers dealing with more generalised matters is also envisaged. Thus the first number contains in addition to a number of chemical papers, an article on the world food situation and the work of the FAO by Viscount Bruce, while articles of similar type by accepted authorities will appear in subsequent issues.

In its earlier days the Society confined itself almost exclusively to the application of chemistry to industrial manufacture, but more recently its field has extended to other and wider aspects of applied chemistry, as witness the existence of separate groups within the Society concerned with food and with agriculture.

Smoke Generators for Protecting Stored Crops, by Dr. H. W. Chatfield, which appeared last month (Vol. 2, pp. 70-73) is copyright and no part may be reproduced without permission.

World Cereals Today

THE MILLETS

H. H. MANN, D.Sc.

Woburn Experimental Station

The millets have received less attention from the scientist than any other cereal crop. Nevertheless they are of great importance since they are the staple food of perhaps one-quarter of the world's population. They are little grown in the more advanced countries, but in Africa and parts of Asia they are the dominant cereal; they are essentially a poor man's crop, and in these regions he depends upon them for the sustenance of himself and his animals. There are many forms of millet and there is reason to suppose that under some conditions they might be suitable as a livestock and possibly human food in areas outside those in which they are at present grown. Furthermore, judging from the success of such work on other cereal crops, there is abundant opportunity for the plant breeder to improve millet strains at present cultivated.

IT is rather astonishing that so little attention is normally directed to the study of the culture, growth and improvement of the various kinds of millet that are produced in many countries of the world. And yet perhaps it is not really astonishing. The millet grains take no considerable part in international commerce. They are, in all countries, the food of the poorer classes and the feed of animals. They are little cultivated in the more advanced agricultural regions. On the other hand, it must not be forgotten that they form the principal food grain of perhaps one-quarter of the world's population. They are the dominant cereals in the whole of Africa except the north and possibly the south, and are grown in India on about 60 million acres with an estimated production of 12 million tons of grain. They are the mainstay of the people of northern China and Manchuria, and are especially important among the nomadic peoples of central Asia as well as a substantial factor in the cereal production of south-east Russia.

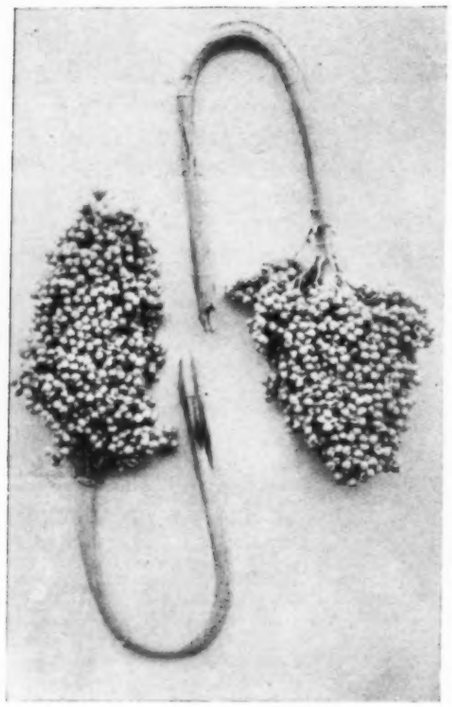
Moreover, the millets have certain advantages over any of the more usual forms of cereal, at any rate in the warmer parts of the globe and in countries with a short but very hot season. Some of them, notably the various *Panicum* millets, grow very rapidly and ripen more quickly than any other cereal crop. Hence they are suitable where the rainy season is very short. Some of them resist drought in a remarkable manner and can be grown where no other summer crop can be profitably cultivated. They are less exhausting than maize and some of them will flourish on land that is too thin and too poor to grow any other cereal. They need less attention than maize, though they will repay care. They are attacked by few insect pests except the borers which are the curse of the sorghum millets, but even here they are less susceptible than maize. Most of them flourish under high temperatures, a very important advantage in many continental climates. All these factors determine the position of the millet crops and their maintenance as extremely important sources of human and animal food in the hotter and drier regions of the world.

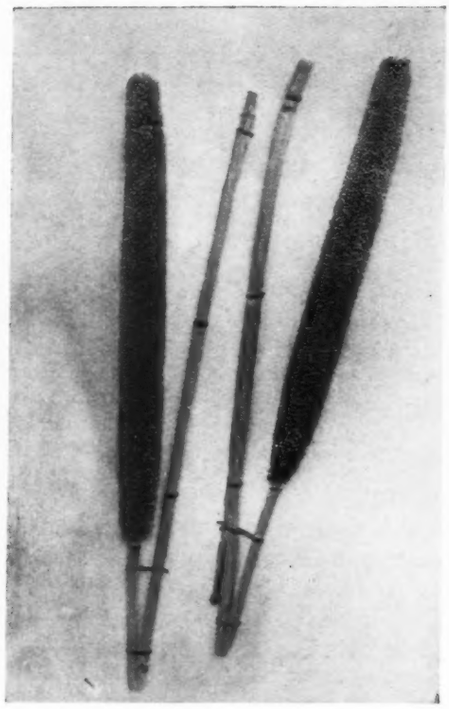
Origin of cultivated forms

Unlike wheat, barley, and oats, none of the millets seem to have had their origin in south-west Asia, where so many of the cultivated crops of the world were almost

[*Photo: courtesy of Imperial Inst.*

Threshing the grain by flail





(Left) *Heads of Sorghum millet from Aden (note 'goose-neck')* (centre) *Heads of Bulrush millet from Bellary, India* (right) *Plant of Finger millet from Uganda*

certainly developed. Sorghum, or Great Millet, the most widely distributed and the most valuable of them all, appears to have come from either India or Africa. The various *Panicum* millets, including *proso* millet of Russia and the so-called Italian millet, are of central or eastern Asian origin. Bulrush or pearl millet comes almost certainly from Africa, though it is now the second most important millet in India. Finger millet, the *ragi* of India, which is cultivated on 7 million acres in that country, has very probably been developed there. But whatever their origin, they spread into all civilised regions in very early times and traces of them have been found estimated to date from as early as 750 B.C.

Status of the millets

It is more difficult to get data as to the status of millet crops at present in various parts of the world than with any of the other generally used grains, owing, as stated above, to the fact that they are almost entirely used in the countries where they are grown and so take only a very small part in international commerce and are of only minor interest to the merchant classes of the world. In most countries the area under millets is not separately recorded, except in a few cases with sorghum. India is perhaps the greatest exception to this statement, for there three of them are stated separately, namely sorghum, bulrush millet, and finger millet (*ragi*). This is, however, the country where they assume their highest importance, forming the food of both animals and men in all except the wetter tracts where rice is the staple, and in the extreme north where wheat is paramount.

Their importance is almost equally great in China where, in regions north of the Yangtze and even in some provinces to the south of that river, millets, especially sorghum, are again the main food of man and beast. In Africa, the universal cultivation of millets has to a certain extent been broken by maize which has tended to replace them in recent years. In central Asia where *proso* and Italian millet have been the dominant grain, there is also a tendency for them to be replaced by maize, while in Europe, where (except in some parts of the Balkans) millets have always been very minor crops the area has lately tended to decline in favour of other grains.

Sorghum or great millet

By far the most important of all the millets, and, in fact, the only one which has gone into large scale cultivation outside its homelands, is sorghum or the great millet. This has proved of very great use to agriculture in areas too hot and dry to grow wheat, barley, or even maize well. It is the only one which has been so studied as to produce materially better varieties than those used in its original homes. The two great regions for sorghum cultivations are Africa and India, with a subsidiary but important area in north China and Manchuria. In recent years it has become a very large crop in the U.S. prairies. In most of the countries where it is cultivated, sorghum is valued as an irreplaceable element in the cultural system, becoming in many areas the staple food for man and beast. The plant is a native of the tropics, and although many varieties now available will grow and ripen under less extreme conditions, it cannot be considered as a possible culture in really temperate climates. It occupies between 20 and 25 million acres in India. For Africa and China no statistics are available. In the U.S.A. it covers about 10 million acres. All over the Middle East it is found, becoming more and more important as one proceeds to the south. Smaller areas are found in the Argentine and other parts of the western hemisphere.

Where there are at least 160 days free from frost, where there is a rainfall of from 18 to 40 in. per annum, and where the average temperature during the growing season is above 76°F., conditions are suitable for the grain sorghums. The main advantage that sorghum has over maize is that it needs less rainfall; where there is abundant water the tendency is for the crop to be replaced by maize, as is now happening in Egypt. But in a country liable to small or poorly distributed rainfall, the sorghum plant has the faculty, not possessed by maize, of remaining dormant during short periods of drought when maize would be killed or greatly damaged. This

Library University of Mo.

is a very important quality in countries where, as in many parts of India and the Middle East, such poor distribution of rain is likely during the growing period. Further, sorghum is less exhausting than maize; for example, it has been found in Palestine that although legumes must be grown after maize, a second cereal crop can be taken after sorghum. The superiority of sorghum over maize in a region of limited rainfall is shown by the fact that the water requirement per lb. of dry matter produced is less than for any of the common grains. Again, while maize is rather sensitive to alkali in land, sorghum will succeed on soils where the concentration of salt in the soil is bound to be considerable even though it does not appear as an incrustation.

Sorghum grain is not capable of making good bread with yeast when used alone, but it can be mixed to the extent of 20% with wheat without spoiling the bread. On the other hand it grinds easily, is economical in use and can be eaten either as a porridge or in the form of unfermented bread, as is common in tropical countries. It is excellent as a cattle food and in some Asiatic countries 50% of the production is so consumed. Tests indicate that it may be about 89% as efficient as maize for this purpose.

One of the great advantages of sorghum as a crop is that the straw, even after the grain is ripe, remains a good fodder. This is not so much the case with the northern early types, such as those grown in China and Manchuria, as with the more tropical kinds where, as in India, sorghum straw is the chief cattle fodder almost throughout the year. The leaves remain green much later than do those of maize, while none of the other millets are equal to it from this point of view. Though there is danger in feeding fodder from immature or stunted plants there is nothing against the mature straw. Of course sorghum *can* be grown for fodder only, being cut when the grain is in the milk stage. Special varieties are kept for this purpose in India, and in most other countries where the crop is cultivated, and it has been stated with truth that no other crops can compare with sorghums in yielding a heavy weight of fodder of good quality.

Varieties of sorghum are innumerable in Africa and in India, each more or less adapted to local conditions. They are, however, short day plants, that is to say, the heading and flowering are hastened by short days and delayed by long days. Most varieties from the tropics will not head when brought to higher latitudes and those developed in Manchuria are found to be very early when taken to the south. As earliness is very important in many of the areas where sorghums would be suitable, the *kaiolangs* of northern China may form a very good source for early ripening types.

The commonest types of sorghum for grain are those with a very compact head in many of which the tip of the stem is often curved so that the head hangs down in a way that is called 'goose-neck,' though a much looser type of panicle is common enough. Except in areas where irrigation is available, the qualities mainly desired are (a) early ripening plants not needing more than three to four months to mature in the hotter parts of the year, (b) short plants not more than six or seven feet high, (c) very dense heads with grains full at the top and the bottom, (d) a high yield of grain.

[*Photo: courtesy of Imperial Inst.*

Hoeing the crop—the young sorghum plants are kept free from weeds

Bulrush millet

Two millets are exclusively cultivated in tropical and semi-tropical areas, and chiefly or even entirely in India and Africa. The first of these is bulrush or pearl millet (*Pennisetum typhoideum*), almost certainly a native of Africa, but now the second of importance among the millets of India where there are annually about 14 million acres under the crop. It seems to be exclusively grown where the rainy season coincides with the hotter parts of the year. It is usually considered an inferior grain and is found on the poorer, lighter lands. It requires little rain but cannot stand nearly as long a period of drought between rains as sorghum, while it requires a high temperature to mature the crop.

Its great advantage is that it will grow well on lighter and poorer soils, that it is less susceptible to disease and insect attack, and that it will yield well on a minimum of rain. As a result of its relative immunity to borers, it has almost entirely replaced sorghum as an irrigated crop in certain areas of Sind, but its growth there under irrigation is quite exceptional. Under favourable conditions it ripens in about 100 days in western India, being sown in June after the advent of the monsoon, and reaped in September. The fodder from the ripe plant is used for cattle, but it is recognised as inferior.

Finger millet

Extending over the same areas as the last-mentioned millet, but on a far more restricted scale, is finger millet (*Eleusine coracana*), whose origin is almost certainly in India, where it is still the main rains

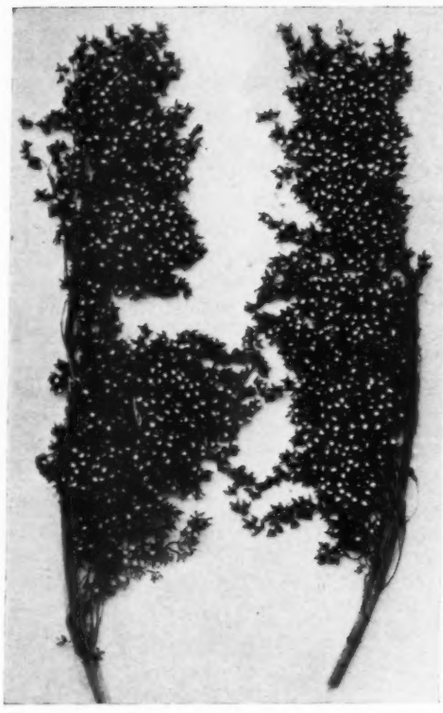
crop of poor upland regions with a fairly good rainfall but with too porous a soil for rice, especially in the south of the country. Here on the Mysore plateau it is grown to the greatest extent, and altogether there are no less than 7 million acres under the crop in India. Finger millet needs about three to four months to ripen, and may yield from 700 to 1,000 lb. of grain and over 2,000 lb. of straw per acre. Two essentials of its cultivation are sufficient rain during its growth, a porous soil so that at no time is it likely to be waterlogged, and a high temperature during all its growth with a mean of over 75°F.

As a food it is almost entirely used by the labouring classes. It is not a dainty food, but is highly nutritious, and its importance is shown by its total production being about 1¼ million tons of edible grain. The yield in other countries where it has been grown is not obtainable, but it forms a not inconsiderable factor in the food supply of tropical and semi-tropical countries where rice cannot be grown. I am not at all certain that finger millet might not be of much greater value than has yet been realised in the upland areas of East Africa where the soil is too porous for sorghum or even for bulrush millet.

Panicum millets

There is another class of millet which is at least as interesting as those already dealt with. Wherever there is a hot summer, whether in tropical or higher latitudes, where the rainy season is short, where the soil is thin and poor, and especially where a crop is wanted which, with little effort, can be relied on to give a fairly large amount of fodder as well as of grain, there one or more of the *Panicum* millets will be found. The northern limit of the cultivation of these essentially semi-tropical crops appears to be about a June isotherm of 63°F., and a July isotherm of 68°F. There are four important species of this type of millet.

Panicum miliaceum, the common *proso* millet of Russia, has now spread far in the Middle East, in India, and in the U.S.A. The heads of this millet consist of large open-branching panicles (see accompanying photograph) somewhat like those of oats. It has coarse hollow stems usually about 30 in. high. It is sensitive to frost and so cannot be sown till late in the spring when the ground is warm and, if possible, moist. This millet grows slowly at first, but with increasing heat it comes on very rapidly and ripens in from 50 to 60 days after sowing. It seems to have the lowest water requirement of any grain crop. Its roots are very shallow, but it grows well on any kind of soil except coarse sand, and is well adapted for plateau con-



Heads of Sorghum millet from Southern Nigeria

Head of Proso millet from Kiang-Su, China

ditions and high elevations. In dry areas only 22 lb. of seed per acre are needed for sowing. It is not usually considered as suitable for irrigation, though in central Asia it is irrigated. The straw does not make very good fodder.

The yield of grain under the conditions where it is usually grown, on poor soil without manure, after another grain crop, is from 450 to 700 lb. per acre, though as much as 2,000 lb. have been obtained under favourable conditions. When used for human food it has an agreeable taste with a slight nutty flavour, and it is usually cooked into a sort of porridge. For animal feeding it seems rather better than oats and not quite so good as barley.

The best types of *proso* millet for areas where the growing season is short (and these include the regions where it is likely to have great value) are probably those from south-east Russia, where much effort has been spent to improve the crop. These are said to be much earlier than the varieties from China and India.

Panicum miliare, or the little millet. This is often confused with the last-named and perhaps hardly deserves special mention, though it is extensively cultivated in India, particularly in the south. It is noteworthy, however, for its reputation of growing on the poorest and otherwise worthless lands. It can withstand both drought and waterlogging and gives a yield similar to that of *proso* millet.

Setaria italica or Italian millet is grown on almost as large a scale as *proso* either as a crop or as an admixture. It is the chief millet in cultivation in Japan, and has the advantage that its straw gives an excellent fodder and if cut when in flower makes first-class hay. For this reason it has extended quite widely in the U.S.A. almost entirely as a heavily-yielding rapidly-growing fodder crop.

Like *proso*, it should not be sown till the land is warm and a little later than maize. It ripens later than the *proso* millets but can be cut for grain in from 70 to 80 days after seeding. A good crop of seed would be about 800 lb. per acre, with 2,500 lb. of straw.

Echinochloa frumentaceum or poor man's millet can hardly be considered as a crop in the ordinary sense though it occurs almost everywhere where the other *Panicum* millets are found, often as a pernicious weed. It is the quickest growing of all the millets and has been known to give a crop of ripe grain in 45 days after sowing. When grown in the northern hemisphere it is sown about the middle of June when the soil is moist. Rain is then needed till August, when the crop is cut. This presupposes a monsoon climate with rain in summer and, apart from irrigation, it seems very doubtful whether there is much place for this millet in agriculture. It is used in Egypt as a reclamation crop on lands too salt for rice, and is worth consideration for a similar purpose in the rehabilitation of other salty areas.

General conclusions

This summary of the present position of the millets in world agriculture would not be complete without some consideration of the future. There seems little doubt that there is scope for a much more extended use of sorghum as a crop in areas where maize can hardly be grown owing to the shortness and uncertainty of rainfall. This might be illustrated by the recent developments of coarse grain growing in Queensland for animal feeding and export,* based almost entirely on sorghum production. I doubt whether sorghum has much future under irrigation, except possibly as a pure fodder crop, for the only advantages that sorghum has are its capacity to flourish where water and manure are short and where the attention that maize requires cannot be given. On the other hand, the market for maize grain is a better one, for this is usually preferred both for human food and for animals.

But where irrigation is not available and rainfall is short, sorghum seems the food crop *par excellence* for the summer in the hotter countries, just as wheat and barley are the natural autumn and early spring crops. But in order that the extension of which sorghum is capable should take place, there will have to be a great deal of local selection of the most suitable types with a capacity to ripen early, with a somewhat dwarf habit, with dense heads and consequently a high yield of grain. There are immense areas in Africa and in the Middle East where there is an opening for such types.

The place of the *Panicum* millets in the agricultural systems of the future seems still more certain if only the best types are evolved and brought into general cultivation. There is real need for food and fodder crops that grow under high temperature conditions, ripen quickly, and grow on poorer land than the alternatives available. The *Panicum* millets have too often been, in the past, considered as nomads' crops which would tend to disappear as nomadic life became less usual. But the experience in south-east Russia shows how they can be a very important feature in agricultural life where it is almost impossible to grow profitably any other cereal crop. To achieve their place on the plateau lands of south-west Asia and of Africa, however, they will have to be much more closely studied than they have been in the past, and the very great admixture of one type with another (as of Italian with *proso* millets) will have to be reduced or entirely eliminated. But I can picture millions of acres now looked on as useless even to a peasant agriculture, being brought at least into subsistence cultivation by the proper use and extension of the growing of the *Panicum* millets.

*For an account of this see WORLD CROPS, 1949, **1**, 1, p. 28.

[*Photo: courtesy of Imperial Inst.*

A field of sorghum (ripe Feterita) ready for harvesting. The heads of ripe grain are cut off singly with a knife and piled in a heap to dry

[*Photo: courtesy of Imperial Inst.*

Winnowing—grain is winnowed or cleaned by being thrown into the air by a spade so that the chaff is blown away

Recent Promotions in the Colonial Agricultural Service

O. J. VOEKLER, Director, West African Cocoa Research Institute, Gold Goast, to be Director of Agriculture, Federation of Malaya.

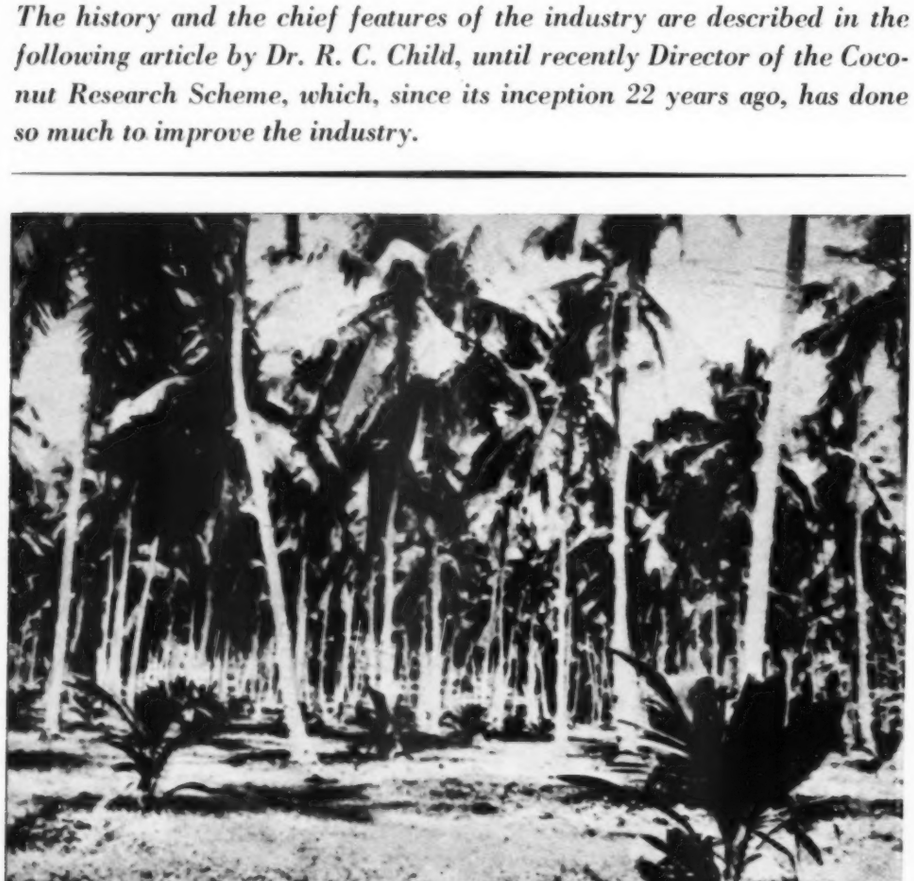
J. WEST, Principal Research Officer, West African Cocoa Research Institute, Gold Coast, to be Director, West African Cocoa Research Institute, Gold Coast.

The Coconut Industry of Ceylon

R. CHILD, B.Sc., Ph.D (Lond.), F.R.I.C.
Formerly Director, Coconut Research Scheme, Ceylon

The coconut is among the most versatile of crop plants. Coconut oil is a most important vegetable oil; the margarine and soap industries of the world depend on it very considerably for their raw material. The press cake, poonac, is a useful stock feed, desiccated coconut is much used as a food, coconut coir is a valuable textile, coconut shell charcoal is used as a decolouring and deodorising agent, sugar and alcohol can be produced from the sap, and other uses are found for parts of the palm. Ceylon has for long been one of the world's chief sources of coconuts and coconut products, ranking in this regard with the Philippines and Indonesia. In the island itself coconuts share with tea and rubber the roles of principal export staples, while they are also of high importance as articles of domestic consumption.

The history and the chief features of the industry are described in the following article by Dr. R. C. Child, until recently Director of the Coconut Research Scheme, which, since its inception 22 years ago, has done so much to improve the industry.



A coconut grove in Ceylon

THOUGH it is generally agreed that the coconut palm is not indigenous to Ceylon, it has been long established on the island. There is mention in the Mahavansa, Ceylon's ancient chronicle, of the planting of coconuts by Agrabodhi I about A.D. 589 and he is supposed by legend to have been the first to introduce coconut cultivation into Ceylon. The palm had probably been grown in the south of Ceylon for some centuries before Agrabodhi's time, but the persistence of his legend may be taken to indicate a time when it was unknown.

Up to the end of the 18th century coconuts were, apart from some trade with India, of local importance only; they were an important domestic crop supplying a variety of products useful in village economy, and their cultivation was general. At the beginning of the 19th century it was roughly estimated that Ceylon contained 10,000,000 coconut palms, mostly in village holdings; assuming fairly close garden planting, this would correspond to about 50,000 acres.

At this time exports to Europe had hardly begun, though there was a small trade with India in coconut oil and coir products. The first shipment of coconut oil to Europe is said to have been taken in 1820; the demand, however, was limited.

The earliest patent covering the use of coconut oil in soap seems to be that of R. L. Sturtevant, E.P. 8870 of 1841, which is nearly contemporary with the opening of the first European plantations in Ceylon. This patent recognised the characteristic valuable properties of coconut oil in soap-making and led to widely increased demand in industrial countries—a demand which Ceylon did much to fill.

The first European plantation was opened in the northern province in 1820. In the 1840s several estates were opened in the eastern province. The 'Ceylon Diary and Almanac' for 1852 refers to coconut estates in Trincomalee and Batticaloa (eastern province) and Jaffna (northern province), and to a few in the

western, north-western and southern provinces. Some of these early ventures were not very profitable and, indeed, the northern and eastern provinces are, on the whole, too dry for really successful coconut cultivation.

There was a slackening in the rate of new planting between about 1850 and 1860. After that, progress was rapid; the Government released at this time much of the low country reserves of Crown land on favourable terms; the consequent extension of coconut planting, especially in the west of the island, was largely Ceylonese enterprise. Accurate records of the areas planted are not available, but Ferguson (whose *All About the Coconut Palm*, first published in Ceylon in 1885, went through several editions) reckoned that in 1860 there were about 250,000 acres of cultivated coconut land, which had increased by 1900 to 650,000 acres.

Government estimates were considerably higher than Ferguson's; the official figure for 1900 was 846,000 acres and this gradually rose to 1,100,000 acres in 1931. The latter figure was until recently that regularly quoted in works of reference.

Present acreage under coconut palms in Ceylon

In the course of the census of 1946, an effort was made to obtain more accurate agricultural statistics than were previously available. The following are the figures of coconut acreages published in a preliminary census report in *Ceylon Government Gazette Extraordinary*, No. 9,764 of September 16, 1947:

TABLE 1. CEYLON'S ACREAGE UNDER COCONUTS, EXCLUDING TOWN AND VILLAGE GARDENS

Province	*'A' estates*	*'B' estates*	*Total*
North-western	73,348	346,342	419,690
Western ..	17,551	215,683	233,234
Southern ..	3,726	99,197	102,923
Sabaragamuwa	2,227	80,063	82,290
Central ..	6,945	25,223	32,168
Northern ..	—	24,232	24,232
Eastern ..	3,397	17,918	21,315
North-central	182	2,580	2,762
Uva ..	60	1,419	1,479
	107,436	812,657	920,093

An 'A' estate is defined as one which is 20 acres or more in extent and has ten or more resident labourers. A 'B' estate is one of 20 acres or more in which the number of resident labourers is less than ten.

The total area given in the census 1946 returns as town and village gardens (cultivated area) was 309,381 acres. A large proportion of these contain coconut palms and, taking these into account, it would seem that the old estimate of 1,100,000 acres as the coconut area of Ceylon was not seriously in error.

It is worth noting that the western and north-western provinces contain about 70% of the total coconut area and nearly 90% of the 'A' estates.

A coconut palm, showing habit of bearing fruit in bunches of from 12 to 20

Products

Coconut Oil. The coconut oil milling industry in Ceylon has been long established, and oil was, in fact, shipped in quantity before copra became an important export. Credit is usually given to Sir Edward Barnes, Governor from 1824 to 1831, for encouraging the introduction of mechanical oil presses; the first steam-power mill was established by Ackland, Boyd & Co. in 1833.

Exports of coconut oil showed an almost uninterrupted increase up to 1939. After 1870 new acreages of coconuts were coming into bearing; local consumption of the oil was reduced by the introduction of paraffin for lighting purposes.

A second great fillip to the consuming demand (use in soap manufacture having given the first) was given by the increased use of coconut oil in margarine after 1900, the earliest patent on which was Ruffin's E.P. 1827 of 1896. Ceylon's production continued to expand to meet the increased demand; the introduction by the V. D. Anderson Co. in 1901 of the first continuous oil expeller was a big technical advance. Expeller equipment is more suitable to the small miller than hydraulic equipment, which involves a larger capital investment and its application led to further extension of oil-milling in Ceylon.

Copra. Before 1880 local mills were apparently able to deal with all the exportable coconut produce and exports of copra were not large. Thereafter, estate production increased more rapidly than oil-milling capacity, and exportable surpluses of copra became available. After 1905, indeed, copra exports exceeded those of coconut oil and reached over 100,000 tons annually by 1925. Oil-milling was, however, still expanding and by 1935 was beginning to overtake the copra surpluses.

During the war years 1939-45, copra was the principal export, but oil milling was resumed on a pre-war scale by 1948.

Desiccated Coconut. Desiccated coconut was being made in England and in the

U.S.A. in the early 1880s from imported nuts. This is, however, unecomic compared with production in coconut-growing countries, and by 1890 manufacture was under way in Ceylon; the commodity first appeared in the Ceylon customs returns for 1891, when 632 tons were exported. Production increased steadily, 7,244 tons being exported in 1903; from 1911 to 1918, exports were fairly steady round 14,000 tons annually. After the war of 1914-18, the industry expanded and reached its peak of 43,641 tons exported in 1927. Thereafter, owing to Philippine competition, aided by a differential U.S. tariff, production fell off and up to 1938 exports averaged about 30,000 tons a year. During the war years 1939-45 manufacture was severely limited, and exports are (1949) still under control by Government quota; 11,825 tons were exported in 1948.

Coir Products. Coir was first exported from Ceylon when the island was ruled by the Dutch. In 1846 over 1,000 tons a year were being shipped, valued at over £10,000 and exports were comparable in importance with coconut oil. In 1939, however, coir represented only about 10% of the value of all exported coconut products, but whilst their importance had declined relatively, their absolute quantity and value had increased enormously.

By 1881-86 Ceylon's exports of coir products had reached 5,000 tons a year and were double this by 1900. The machine manufacture of bristle fibre, introduced during the period 1880-90, having resulted in a large expansion of the industry.

In the years immediately before 1939, annual exports averaged about 30,000 tons of mattress fibre, 10,000 tons of bristle fibre and 5,000 tons of coir yarn. During 1949-45 exports were on a much reduced scale, but by 1948 those of mattress fibre had reached pre-war level. The virtual absence of Japanese buying prevents the recovery of bristle fibre exports.

Minor Exports. *Coconut cake ('poonac').* Coconut cake is produced as a by-product in the milling of copra. With efficient expellers good estate copra yields 61.5% of oil and 34.5% of cake, with about 4% driage and mechanical loss. Up to 1939, almost all of the poonac produced in Ceylon was exported, a large proportion going to Belgium; in round figures poonac exports weighed about half of the contemporary oil exports.

The loss of the usual markets in 1940 compelled the increased use of poonac within the island, with consequent greater appreciation of its value as a cattle food. As a result, the local price is controlled and export largely restricted.

Coconut shell charcoal. Between 1933 and 1940 appreciable quantities of pit charcoal made from coconut shells were exported. The peak year was 1939, when 18,568 tons were exported, valued at Rs.1,361,880.

Trade statistics, 1911-1948

The previous section gave an outline of the development of Ceylon's exports of coconut products; the following tables give details of the export trade from 1911 to 1948. The figures are from the customs returns and have been grouped into four-year periods to average out to some extent variations due to climatic and other causes.

To facilitate comparison between different periods, it is convenient to convert the different products to a common basis of coconuts:

1 ton of copra equivalent to 5,000 nuts
1 ton of oil equivalent to 8,125 nuts
1 ton of desiccated coconut to 6,900 nuts

In Table 3 are summarised the total exports as nut equivalent calculated on this basis; the totals are averages for the four-year periods as in Table 2.

It is apparent from Table 3 that Ceylon's exports, which increased steadily up to about 1934, have since shown a declining tendency. This is partly to be accounted for by increasing local consumption.

Local consumption. Coconuts enter largely into the domestic economy of the Ceylonese and provide most of the fat in the local dietary. Toddy products—including the distilled spirit, arrack, and toddy vinegar—are not dealt with in the present article; less than 1% of the coconut palms in Ceylon are tapped for toddy.

TABLE 2. EXPORTS OF COCONUT PRODUCTS FROM CEYLON

Years	Oil (tons)	Copra (tons)	Dessicated coconuts (tons)	Whole coconuts
Average 1911-14	24,251	49,564	14,833	15,006,280
,, 1915-18	22,334	60,868	14,132	5,591,181
,, 1919-22	27,786	77,142	35,407	14,805,870
,, 1923-26	27,768	93,472	40,483	21,263,716
,, 1927-30	38,682	97,674	38,183	19,615,890
,, 1931-34	55,576	77,344	33,814	24,350,762
,, 1935-38	58,045	61,642	30,109	16,205,255
,, 1939-42	36,430	87,022	14,673	7,693,929
,, 1943-46	42,783	100,268	5,319	20,799,072
1947	42,315	29,735	11,550	3,801,400
1948	75,730	54,461	11,825	9,387,137

TABLE 3. NUT EQUIVALENT AND VALUE OF CEYLON'S EXPORTS OF COCONUT PRODUCTS. ANNUAL AVERAGES FOR FOUR-YEAR PERIODS

Years	Exports as nuts (millions)	Value as rupees (thousands)	Average value per 1,000 nuts Rs. c.	As % of 1911-14 average value	As % of 1931-42 average value
Average 1911-14 ..	562.0	38,860	69.15	100	—
,, 1915-18 ..	588.9	36,674	62.27	90	—
,, 1919-22 ..	870.6	71,208	81.79	118	—
,, 1923-26 ..	993.6	69,304	69.75	101	—
,, 1927-30 ..	1,085.7	60,616	55.83	81	—
,, 1931-34 ..	1,096.0	28,221	25.75	37	
,, 1935-38 ..	1,007.2	31,429	31.20	45	100
,, 1939-42 ..	840.4	28,310	33.70	49	
,, 1943-46 ..	906.7	58,616	64.65	93	216
1947	576.0	93,692	162.67	235	544
1948	978.6	153,445	156.80	227	525

TABLE 4. ESTIMATED ANNUAL PRODUCTION OF COCONUTS IN CEYLON

Years	Average population (approx. 1,000s)	Local consumption of nuts per year (approx. millions)	Annual exports, nut equivalent (millions)	Total annual production (millions)
1911-14	4,166	541.6	562.0	1,103.6
1915-18	4,326	562.4	588.9	1,151.3
1919-22	4,500	585.0	870.6	1,455.6
1923-26	4,720	613.6	993.6	1,607.2
1927-30	5,045	655.8	1,085.7	1,741.5
1931-34	5,472	711.4	1,096.0	1,807.4
1935-38	5,700	741.0	1,007.2	1,748.2
1939-42	6,100	793.0	840.4	1,633.4
1943-46	6,390	830.7	906.7	1,737.4
1947	6,700	871.0	576.0	1,447.0
1948	6,950	903.5	978.6	1,882.1

A copra storehouse. The copra is laid on the concrete square to dry under the sun

It is difficult to assess the total equivalent of coconuts locally consumed, although an estimate of 130 a year per head of the population is consistent with nutrition surveys that have been made. On this basis the figures given in Table 4 have been calculated for estimated annual production of coconuts in Ceylon, *i.e.* by adding the equivalent in nuts of known exports to a roughly computed estimate of local consumption.

Productivity. Estimates of production arrived at in this way are admittedly very rough, but before 1946 none other were possible. At the 1946 census, an attempt was made to obtain returns of 1945 crops.

Fairly complete figures were obtained for the 'A' estate, which gave an average of 2,114 nuts per acre. For ' B ' estate, figures are only so far available for 111,055 acres in the north-western province, which gave an average of 1,323 nuts per acre.

Assuming that the average yield for all 'A' estates is 2,114 nuts a year and for all ' B ' estates, 1,323 nuts a year per acre (the latter would be an over-estimate since yields in other provinces are likely to be lower than in the north-western province), total production on 'A' and ' B ' estates can be estimated as:

'A,' 107,436 acres at 2,114 nuts per acre	227,119,704
'B,' 812,657 acres at 1,323 nuts per acre	1,075,145,211
	1,302,264,915

Allowing an approximate figure of 1,000 nuts an acre for town and village gardens, the total annual production comes out at about 1,600,000,000 nuts a year. The year 1945 was fortunately a normal good cropping one; the figure of 1,600,000,000 is so close to that reached by indirect means (exports plus a necessarily very rough estimate of local consumption) that it can be accepted with some confidence as a basis for discussion.

This productivity — averaging about 1,500 nuts an acre per year (or less than a quarter of a ton of coconut oil)—is realised to be very low and in the present century increasing attention has been paid to the improvement of coconut cultivation. Before the establishment of the Coconut Research Scheme in 1928, much empirical knowledge had been gathered by planters, and the Department of Agriculture had adequately dealt with pests and diseases and had made a start on manurial experiments.

Pests and diseases

Insect Pests. A large number of insects have been recorded in Ceylon as infesting coconut palms (see P. Lepesme, ' Les Insectes des Palmiers,' Paris, 1947), but only four are of economic importance.

The coconut black beetle (*Oryctes rhinoceros*, Linn.) and the red weevil (*Rhynchophorus ferrugineus*, Ol.) are responsible for much damage. Control measures are imposed by order under the Plant Protection Ordinance No. 10 of 1924, but need more stringent enforcement.

The caterpillar, *Nephantis serinopa*, Meyr., is troublesome in the eastern province. A fair measure of control has been achieved by the liberation by the Department of Agriculture of the parasite *Trichospilus pupivora* Ferr. (a natural enemy of the *Nephantis* caterpillar from south India); it seems likely, however, that the parasite will not establish itself indefinitely, but that regular liberation of large numbers, bred at a central station, will be necessary.

The cosmopolitan scale insect, *Aspidiotus destructor* Sign., rarely causes serious damage, being controlled by its natural enemies, particularly in Ceylon the small blue-black ladybird beetle *Chlocorus migratus* F.

Diseases. Fungal and other diseases cause little trouble in Ceylon. Cases of

Young coconut seedlings growing in one of the nurseries opened by the Coconut Research Scheme

genuine bud-rot due to such fungi as *Phytophthen* spp. are rare; most cases of so-called ' bud-rot ' reported are probably the result of injury by lightning, which causes in well-grown palms more casualties than any other agency.

Stem-bleeding due to the fungus *Ceratostomella paradonn* (de Seynes) Dade, was regarded seriously by its discoverer, T. Petch, in 1903. Subsequent experience has, however, minimised its importance and it is not now considered a major malady.

Many estates report palms showing symptoms known as ' tapering.' The leaves become yellow and successive emerging leaves are smaller than their predecessors; the diameter of the trunk shows a corresponding decrease and ultimately the palm dies. In many cases, the palm, when it is felled and uprooted, is found to have been growing on a hard pan; in some cases waterlogging is responsible; almost all palms show somewhat similar symptoms in extreme age. Examples of tapering, however, also occur in which such obvious factors do not operate, and there remains a field for investigation. A more important factor is the fall of immature coconuts, which is often the cause of serious loss of crop and an obvious field for research is open here.

Replanting

Much of Ceylon's existing coconut land was planted in the 1880s; it is likely, therefore, that a large area is due for replanting, especially since there was a general curtailment of agricultural operations (including replanting) after 1930, owing to prevailing low prices (compare Table 3).

The extent to which the need for replanting is a serious problem has been a matter for controversy, and it is indeed difficult to obtain reliable data. An attempt was made to obtain information at the 1946 census, when all managers were asked to give details of the proportion of their coconut palms which were below 10 years, 10 to 30 years, 30 to 60 years and over 60 years. The accuracy of the returns must be limited, since few managers of even well-kept plantations have detailed records of the original plantings; probably the ages were estimated in most cases by inspection. However, they are sufficient to show that a good deal of replanting is urgently necessary. Of the 'A' estates giving returns, about 10% were stated to be over 60 years old and of the ' B ' estates, 16.3%.

Research in coconut breeding has not progressed far enough for guaranteed high-yielding planting material to be available, but the Coconut Research Scheme, Ceylon, has initiated work on selection and testing. The value of stringent seedling selection in the nursery has, however, been demonstrated.

A satisfying start has been made (1949) with an island-wide replanting scheme. With funds provided from the votes of the Department of Agriculture, the Coconut Research Scheme has undertaken the opening of large nurseries in different districts.

Agricultural improvement

Reference has already been made to the low average yield in Ceylon of about 1,500 coconuts per acre per year. Yields of over 4,000 annually (equivalent to about $\frac{3}{4}$ ton of copra or $\frac{1}{2}$ ton of coconut oil) are obtained on suitable land under good conditions of cultivation. The best plantations are found on the ideal loams of the alluvia of the Ma-Oya, Deduru-Oya and Battulu-Oya rivers and their tributaries in the north-western province and the estuarine deposits of the silted-up lagoons of Negonbo (western province), Madanpe, Mundel and Puttclan (north - western province).

During the period of expansion, coconuts were planted on land less suited to the crop, such as the lateritic soils and gravels of medium to poor fertility in the western and southern provinces. All along the west coast there may be found coconut areas on marine sand, and round Negombo on the areas known as ' cinnamon sands,' which are old worked-out soils on which cinnamon was once grown.

Though some lands—as in the eastern province—may have to be abandoned, as they have so deteriorated through senility and neglect, investigation has shown that much can be done to maintain crops at a satisfactory level by manuring and cultivation on the poorer soils.

Manuring. M. L. M. Salgado has recently given an account of the results of the Coconut Research Scheme's experiments over the past 15 years (' Recent Studies on the Manuring of Coconuts in Ceylon,' C.R.S. Bull. No. 6, pp. 26 + 6 diagrams, 1948), to which reference should be made for technical details.

A coconut grove showing use of cover crop Centrosema Pubescens *on a plantation in Ceylon*

[*Photo: courtesy Commissioner, E. African Office*

A native reserve in East Africa

Group Farming

with Special Reference to East Africa

G. B. MASEFIELD, B.Sc., A.I.C.T.A.

Department of Agriculture, University of Oxford

In the issue of this journal for December 1949, Mr. Masefield emphasised that the achievements of increased production in tropical Africa necessitated a revolution in native African farming methods. One way of bringing this about is by organising cultivators in groups whereby they can work with an efficiency approaching that of a large plantation. In this article the author further develops the theme and shows how recent developments in East Africa are helping to bring about the changes needed.

'GROUP farming' is the term now fashionable to describe a kind of system which holds out very real hopes of progress to peasant cultivators in many countries. It is difficult to draw an exact distinction between 'group farming' and 'collective farming,' but the latter term has acquired special associations through its use to describe Russian developments. Collective farming is therefore now generally applied to thorough-going systems which leave little or no scope to individual enterprise, while group farming can be more loosely used to describe various degrees of compromise between the advantages of group services and those of individual farming.

Origin of group farming

To those who think that all ideas of group farming spring from a Russian source, it may be salutary to point out that the great Gezira group-farming scheme in the Sudan was planned by British administrators before 1914 and put into practice in the early 1920s before anything had been heard of collective farming in Russia. The East African governments, too, showed an early interest in this field. In 1921, the Uganda Government ploughed up land in the Siroko valley for cotton planting by groups of farmers from the Bugishu hills, with the aid of three tractors presented by the Empire Cotton Growing Corporation. Unfortunately the scheme proved uneconomic and was abandoned when coffee was found to be a more profitable crop for the district.

Early developments

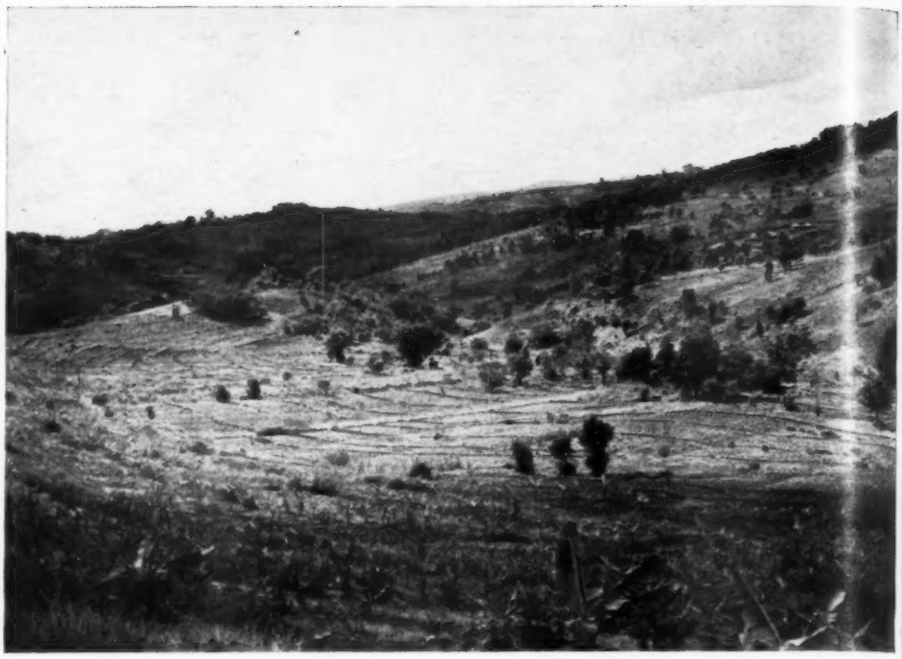
In 1922 a scheme of communal stumping of land in the Teso district of Uganda, followed by ploughing with native administration implements, was tried, but 'the natives were disinclined to abandon their own individual holdings.'[1] Still persisting, in 1929 the Uganda Government allocated £10,000 for clearing and ploughing 100-acre blocks in the eastern province, but again cultivators were unwilling to use the land and, moreover, erosion proved serious on these large surfaces.

Definitions and limitations

Turning to more recent years, it is as well to be clear in one's mind as to what modern developments do *not* constitute instances of group farming. The East African groundnut scheme is in no sense group farming; in this it stands in marked contrast to the projected groundnut scheme for West Africa. The latter will be, if the plans outlined by the West African Oilseeds Mission mature,[2] the outstanding example of group farming in the colonies and will be based on 600-acre units each carrying 20 families with user rights in the land. The East African scheme, on the other hand, is run on ordinary capitalistic lines, though with certain special features which have led some observers to regard it as the prototype of a new *genre*, 'corporation farming.' Nor were the emergency war-time schemes for the cultivation of thousands of acres of wheat in the Masai Reserve in Kenya and on ex-enemy estates at Oldeani in Tanganyika, instances of group farming; cultivation was undertaken directly by the Government through its own servants.

Group services

On the other hand, group services have in certain cases been provided by means other than group farming. Among the benefits to be obtained by the peasant from group farming are the opportunity to make use of modern methods of mechanical cultivation, water supply and irrigation, pest control, crop storage, grading of produce and bulk marketing. Some of these have been provided by other agencies, which are undoubtedly helping the governments and people of East Africa indirectly to feel their way towards a satisfactory basis for group farming. For example, a co-operative marketing society does not in itself involve group farming, but the Kilimanjaro Native Co-operative Union has supplied its members with spraying equipment for use against coffee pests, which is a group service applied to actual farming operations. Again, contractors may supply to a number of farmers equipment which is too costly for the peasant to buy himself; I encountered an Indian in Uganda who hired out ploughs and trained oxen to African cultivators. More recently, the Government has itself entered this field, and in Uganda the Agricultural Department has provided tractors, implements and trained drivers on contract to African farmers with some success on an experimental scale. Finally, direct government services such as the grading and inspection of produce, or the grain conditioning and storage plants erected at Mombasa and Nairobi, provide the producer with facilities which might in the future be developed by local groups.



[*Photo: courtesy Commissioner, E. African Office*

An example of organised cultivation on one of the native reserves

Pilot schemes

The Uganda Development Plan[3] envisages, in the 'pilot schemes' for the agricultural development of selected areas, the provision of certain group facilities for farmers; for example, dams and irrigation systems and workshops for servicing mechanical implements. In the 1930s and 1940s a number of small resettlement schemes were put into force in East Africa, either to accommodate the surplus of over-populated areas or to re-occupy land cleared from tsetse fly. Typical of the former class was the resettlement scheme in the Kigezi district of Uganda, of the latter that at Kingolwira in Tanganyika. In these projects, the amount of group organisation attempted seems in retrospect disappointing. But this was largely because it was felt unwise to dragoon the people into forms of combination which they might be unwilling to accept, when the major difficulty was often to tempt them into the resettlement areas at all. Nevertheless, in these cases the Government inevitably found itself providing some group services, even if only roads or in some cases water supplies or animal quarantine facilities.

A much more deliberate approach to group farming has been adopted in more recent settlement schemes in Kenya. In the Makueni settlement for surplus Wakamba families, the good land is being divided into farms of about 20 acres each, while the poorer land is left for communal grazing, and the farms are to be grouped into larger units of about 2,000 acres each. In another betterment scheme at Belgut in Nyanza Province, according to a recent report, work on three group farms was progressing amidst great enthusiasm, and the first crops were already being grown on planned strips.[4] The progress of these experiments in Kenya will be followed with great interest elsewhere.

Discussions

These various approaches to group farming have aroused much discussion among African administrators on the best lines to be followed. It is obviously possible to experiment with almost any gradation between complete individualism and full-blown collectivisation. One might, for example, conceive a group cultivation of cash crops while retaining individual cultivation of food crops for home consumption. Another very practical suggestion is to apply group cultivation to all crops, but allow livestock to be looked after individually, for livestock benefit much less from collective organisation and much more from personal supervision than do crops. Yet even in such a case, great advantages might be derived by groups from the possession of, say, central creameries on lines analogous to those organised co-operatively by European farmers in Kenya. The fact is, that it is extremely difficult, and perhaps never desirable, to collectivise agriculture completely. This is illustrated even in Russia, where the authorities have not yet felt able to apply universally the fully-collectivised *sovkhoz* farm, but rely for the present

mainly on the *kolkhoz*, which still allows the peasant a small individual patch for food production and a few animals which he can rear himself.

It is comparatively simple to establish new group farms in an unpopulated area on an equitable basis, but to transform existing peasant holdings into group farms is much more difficult. It is sometimes argued that in order to attract peasants into the group farms, it will be necessary to credit each with shares in the unit proportionate to the acreage of land or the number of stock that he contributes. But a system of distributing profits on this basis brings its own difficulties, for the incentive to regular work is undermined for both the large and the small shareholder. It seems that an incentive to steady work can only be provided by rewarding each member of the group mainly on the number of days' labour that he puts in.

It is still premature to indulge in too detailed discussion of these and other knotty problems, which can only be finally solved by experience. But whatever their ultimate solution, there can be no doubt that group farming holds out great hopes for development and that much more will be heard of it in East Africa.

REFERENCES

[1] J. D. Tothill (ed.): 'Agriculture in Uganda,' Oxford, 1940.

[2] "Report of West African Oilseeds Mission," Colonial No. 224, H.M. Stationery Office, 1948.

[3] E. B. Worthington: 'A Development Plan for Uganda,' Govt. Printer, Entebbe, 1946.

[4] "African Land Utilisation and Settlement," Quarterly Report for Second Quarter, 1949. Nairobi, June 1949.

Discussions on African Land Problems

A FEATURE of recent international collaboration in Africa has been the series of conferences attended by delegates from the European countries with African responsibilities, and from the governments of the African countries concerned. At the Anglo-French-Belgian discussions held in Paris in May 1947, a programme of scientific conferences in Africa was drawn up and conferences have already been held to discuss such subjects as tsetse fly and trypanosomiasis and rinderpest. The most recent was at Jos, in Nigeria, where two separate conferences were held. The first, lasting from November 7-15, was the British conference on African land utilisation; the second, lasting from November 17-24, was an international conference on indigenous rural economy.

Land utilisation

The Land Utilisation Conference was held under the chairmanship of Mr. C. G. Eastwood, C.M.G., Assistant Under-Secretary of State for the Colonies. The Secretary of State for the Colonies was himself unable to be present, but sent a special message welcoming the representatives of France, Belgium, Portugal, the Union of South Africa, the U.S.A., Southern Rhodesia, the Anglo-Egyptian Sudan and the Food and Agriculture Organisation of the United Nations, all of whom attended as observers.

'Recent scientific advances,' the message continued, 'particularly in the field of the battle against the tsetse fly, have presented us with new opportunities, but also with new problems. The wise application of our increased scientific and technical knowledge requires a tremendous effort in administration and organisation.'

The conference appointed five committees to consider problems of administration, machinery and legislation; pattern agriculture and livestock development; trypanosomiasis and tsetse fly; conservation, use and development of water resources in rural communities; and staff matters. The findings of the committees were discussed at a plenary session on November 15.

Recommendations

The conference advocated the systematic surveying of soils in development areas and the definition in each territory of the area of forest required. More capital and more advanced methods of agriculture such as mechanisation, irrigation and the use of fertilisers should be introduced. The formation of groups of peasant farmers, co-operating with a body capable of commanding credit and conducting the management from the start, was considered a hopeful method of development which would strengthen the social structure. Such new groups could best be established on unoccupied land under conditions which would encourage the practice of good husbandry, including the carrying of a proper number of livestock. The most promising means of reclaiming land from the tsetse fly was considered to be a bold policy of land utilisation and settlement, and pilot schemes in tsetse-infested areas were recommended.

Indigenous rural economy

The international conference on indigenous rural economy was organised jointly by the United Kingdom, France, Belgium, Portugal, the Union of South Africa, and Southern Rhodesia, and observers from the U.S.A. and the FAO were invited to attend.

The conference was opened by the Governor of Nigeria, Sir John Macpherson, who said that the main object of the conference was to consider the measures required for the economic development of African village communities. The proper development of village communities had special significance for Africa, because in spite of growing industrial development, the main part of the population were still peasant farmers. Many agricultural projects had already been started in Nigeria with the full co-operation of the people, and in Africa as a whole, group settlement, mechanisation and collective farming had all made their appearance.

Recommendations of rural economy

Among the principal findings and recommendations of the conference were:

(1) The use of grass leys which preserve the soil and prevent degeneration.

(2) The need for more research in the field of microbiology.

(3) An extension of domestic economy training among women, who will be able to lead a fuller life owing to the reduction of manual labour.

(4) The introduction at an early stage in the schools' curriculum of an emphasis on crafts and industries, including agriculture.

(5) The establishment of unlimited liability co-operative societies, which are the best means of providing credit to peasant communities.

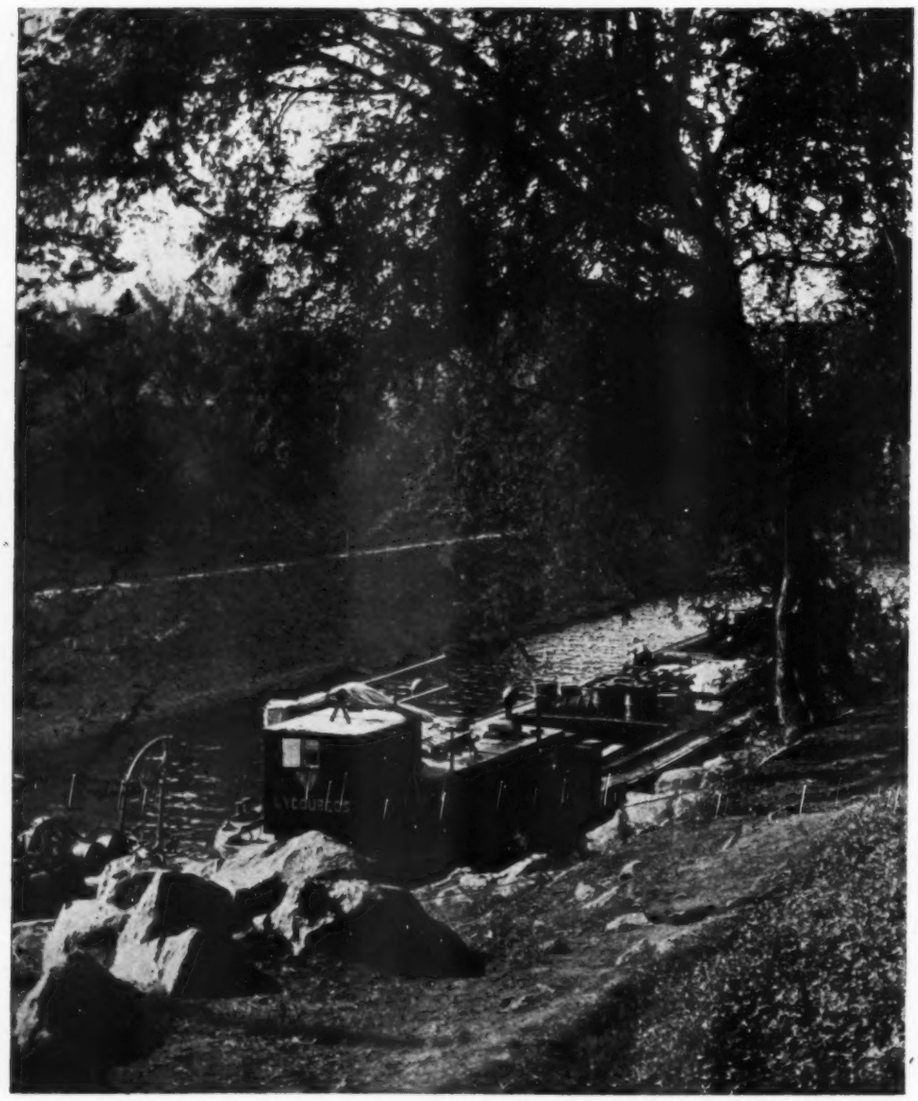
The conference welcomed the opportunity to exchange information about projects already in hand and recommended that the functions of the existing Paris Bureau for the dissemination of information on soil conservation be extended to cover the exchange of information on all aspects of the development of rural economies. Exchange of information was particularly necessary in the fields of water-control technique, the microbiology of African soils, methods of foodstuff storage, mechanical means of processing products within the village community, the use of tractors and other implements, artificial fertilisers and the breeding of suitable strains of grasses for leys.

Egyptian Irrigation Crops and Projected Hydroelectric Schemes

JOHN GRINDROD, B.A.

The Nile is the lifeblood of Egypt, and since the beginning of history the country has depended upon its water to irrigate crops. In modern times expanding populations have demanded that the flow of the river should be conserved and regulated to an ever increasing extent and the available water utilised with maximum efficiency.

During recent years a number of great projects have been carried out to improve the storage capacity for irrigation; the latest schemes include plans for raising the level of Lake Victoria in Uganda to increase storage capacity and the installation of hydroelectric plant at the Aswan Dam, which among other things, will enable the manufacture of nitrogenous fertilisers for use in Egyptian agriculture.



[*Photo: J. Allan Cash, F.I.B.P., F.R.P.S.*

A barge tied up in the shipping canal at Aswan, waiting to enter the locks

SINCE earliest times Egypt has depended on the irrigation waters of the Nile for its food and prosperity. Until 1820 the process was a natural one. The waters of the river overflowed its banks, inundating the basin-like surrounding countryside with floods and leaving behind a rich deposit of silt. The dry, cracked earth steeped up the invading waters from August to October, at which time the dykes were opened and excess moisture was drained back to the river.

Winter crops were then sown, harvested by April or May and the land was left to dry and recuperate.

Perennial irrigation

As time went on the flood-water was gradually controlled. In 1820 the introduction of cotton and other summer (saifi) crops involved a new artificial system of 'perennial' irrigation which became coupled with the old 'basin' system.

During the flood period (August to January) the discharge of the Nile is far in excess of the actual requirements of irrigation and this has been allowed to run waste. If the floods are high the river banks are also exposed to grave risk of breaching, with disastrous consequences to life and crops.

From February to July, on the other hand, the discharge of the river is insufficient for irrigation requirements.

The perennial harnessing of the water consists of dams to store water and to raise the level of the feeder canals, drains for carrying off the water and dykes for protecting the fields against summer flood.

Summer cultivations were at first confined to those areas in the Delta which could raise sufficient water during the summer when the Nile level was at its lowest. To increase this area the feeder canals were dug deeper and pumping stations were constructed to provide perennial irrigation for 2,000,000 acres. To increase this to 3,000,000 acres the Delta barrage was constructed in 1861.

The Nile barrages

The greatest impetus to the development of perennial irrigation, however, was the

building of the Aswan Dam in 1902. This was the first practical answer to the dual problems of water storage and water regulation.

The Aswan Dam, heightened in 1912 and 1933, was followed by another—the Gebel Aulia Dam on the White Nile—in 1937, and these two are used for storing water in order to increase the supplies available in Egypt in the early summer. The Sennar Dam across the Blue Nile, completed in 1925, facilitates the irrigation of land in the Sudan.

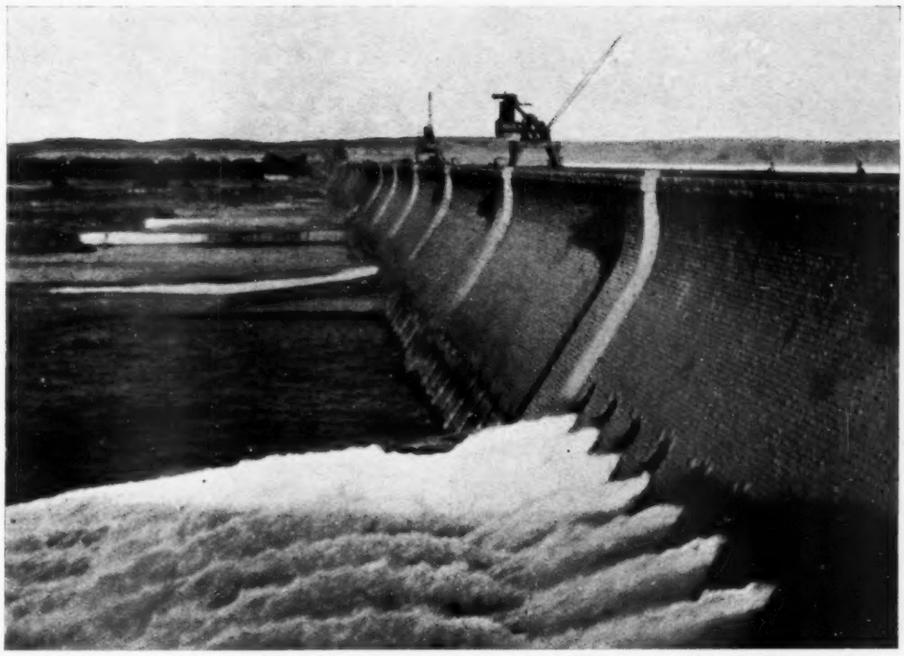
Of the other dams, Esna, Nag Hamadi and Assiut raise the level of the streams and allow the extension of perennial irrigation and improved basin drainage in Upper Egypt. The Mohammed Ali barrage, to the north of Cairo, ensures the supply of the feeder canals of the Delta and the Zifta barrage, on the Damietta branch, raises the level of the lower reachers of the

One of the many falls to be found on the Upper Nile

canals watering the eastern Delta. The pumping stations also fulfil the same function as the regulator dams.

Additional needs

These schemes even out the supply of water during the course of a year. But the flood varies from year to year. In a year of high flood the water cannot be conserved and there is still waste and flood damage. In a low flood year supplies run dangerously short. In order to spread this incidence from year to year a scheme based on what is called ' century storage ' has been put forward. It is aimed to utilise the whole resources of the Nile both for irrigation and hydroelectric power and will be covered by two large schemes—the Equatorial Nile scheme and the Lake Tana scheme. These will involve works on the main Nile in the Sudan, the Blue Nile in Ethiopia and the White Nile in Uganda.



[*Photo: courtesy Egyptian Education Bureau*

The Aswan Dam. Electrification will enable the cultivable area to be extended by more than 40% while also producing power for production of chemical fertilisers

Storage reservoir

On the main Nile an annual storage reservoir is needed in the region between Atbara and Wadi Halfa for flood protection and dry-season storage. On the Blue Nile it is considered possible to convert Lake Tana into a reservoir for ' century storage ' by building a dam at its outlet. By this means irrigation and flood protection in Egypt and the Sudan would be facilitated, and a power station could provide hydroelectric power for Ethiopia. The proposed works on the White Nile include the construction of a reservoir for ' century storage ' in Lake Victoria by building a dam and hydroelectric works at Owen Falls near Jinja in Uganda. Other subsidiary works would be carried out lower down the river.

Tenders have already been accepted for this great joint Uganda-Egypt project at Owen Falls, which is anticipated to cost in the region of £E11,500,000, and work was expected to start in October 1949. Construction of the dam, power house and ancillary works will be simultaneous so as to ensure that the whole of the contract works are completed within four years.

Roughly 400 m. long and 30 m. high, the dam will be built of granite and concrete and its total weight will be 350,000 tons.

Construction of the dam will raise the height of Lake Victoria over its highest recorded maximum level of 1.7 m. to 3 m. This ' lift ' represents 200,000,000,000 cu. m. of water which will be available to increase the flow of the Nile in low years and will provide a continuous discharge of water throughout the year, in contrast to the seasonal fluctuations at Aswan.

Electrification of the Aswan Dam

The electrification of the Aswan Dam is likely to have a twofold effect on the irrigation crops of the Nile. Electricity will be made available for perennial irrigation from artesian wells, thus enabling the cultivable area to be extended from 6,000,000 acres to an anticipated 8,500,000 acres. In the second place, electricity is to be used for the production of large quantities of chemical fertilisers (nitrate of lime), which is expected to increase considerably the crops.

Soil exhaustion

The exhaustion of the soil in Egypt is a very serious problem. When basin irrigation only was practised there was no difficulty. Only one crop a year was taken and the deposit of silt by the flood waters continually enriched the land.

Biennial crop rotation

Under the perennial irrigation system a biennial crop rotation has been practised

which uses a cycle such as the following:

November-May:	Wheat and berseem (Egyptian clover).
June-July:	Fallow.
August-November:	Maize.
December-January:	Fallow.
February-November:	Cotton.

This rotation yields three crops in two years, including cotton, but allows the land only a few months' rest. Furthermore, there is not the same enriching of the land by deposited silt. A minority of landowners practise a triennial rotation by which only one wheat crop and one cotton crop are grown in three years. This is much less exhausting—allows longer rest and summer flooding between the crops. Although yields are higher, on a short-term basis it is not as remunerative as the biennial rotation, and the latter, with the use of large quantities of fertilisers, seems to be the order of the day, in spite of its being detrimental to the soil.

Because of this the use of imported nitrates and superphosphates becomes of prime importance, and it has been estimated that the net increment due to the utilisation of fertilisers in Egypt is E£11,000,000 to E£12,000,000 per annum. There is no systematic use of farmyard manure in Egypt and the average consumption of chemical fertilisers has been reckoned at around 500,000 tons per annum or 60 kg. per acre, compared with 38 in Holland, 15 in Denmark and 8 in France.

Power and fertiliser output from Aswan

It is estimated that there will be two kinds of available energy from the generating station at Aswan: (1) seasonal energy to about 210,000 kW available for eight months in the year, and (2) constant energy of about 50,000 kW available all the year round. When power is short during the flood season, output to industry might be stopped altogether or severely curtailed. Supply would continue for other purposes.

The estimated output of fertilisers from Aswan is 320,000 tons of calcium nitrate and this is expected to be brought up to 460,000 tons by smaller electrification schemes at Esna, Nag Hamadi and Assiut.

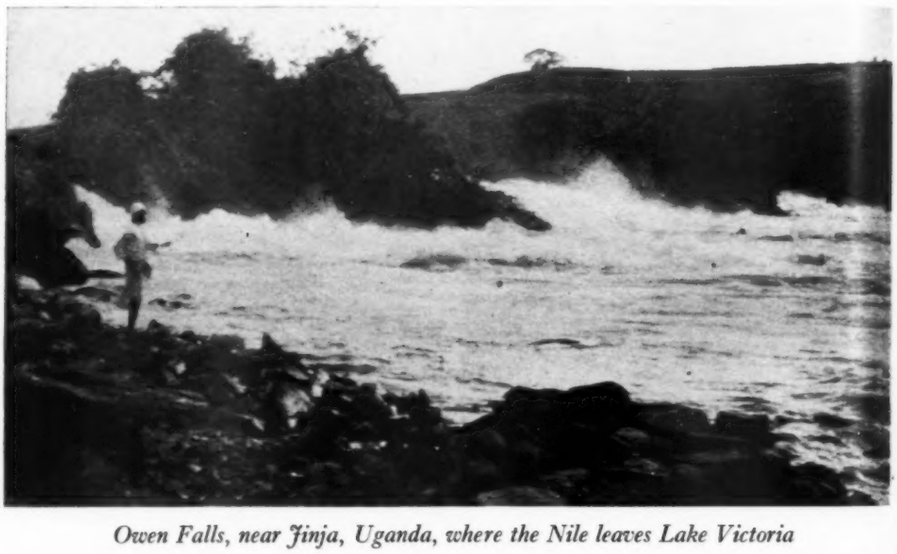
There are at present many acres under basin irrigation in Upper Egypt which grow cotton with water from artesian wells. The pumps are engine-driven and oil is chiefly used. This pumping of water adds considerably to the cost of cultivations, but it is expected that the moderately cheap electric power generated at the Aswan Dam will help toward reducing these expenses.

Drainage problems . . .

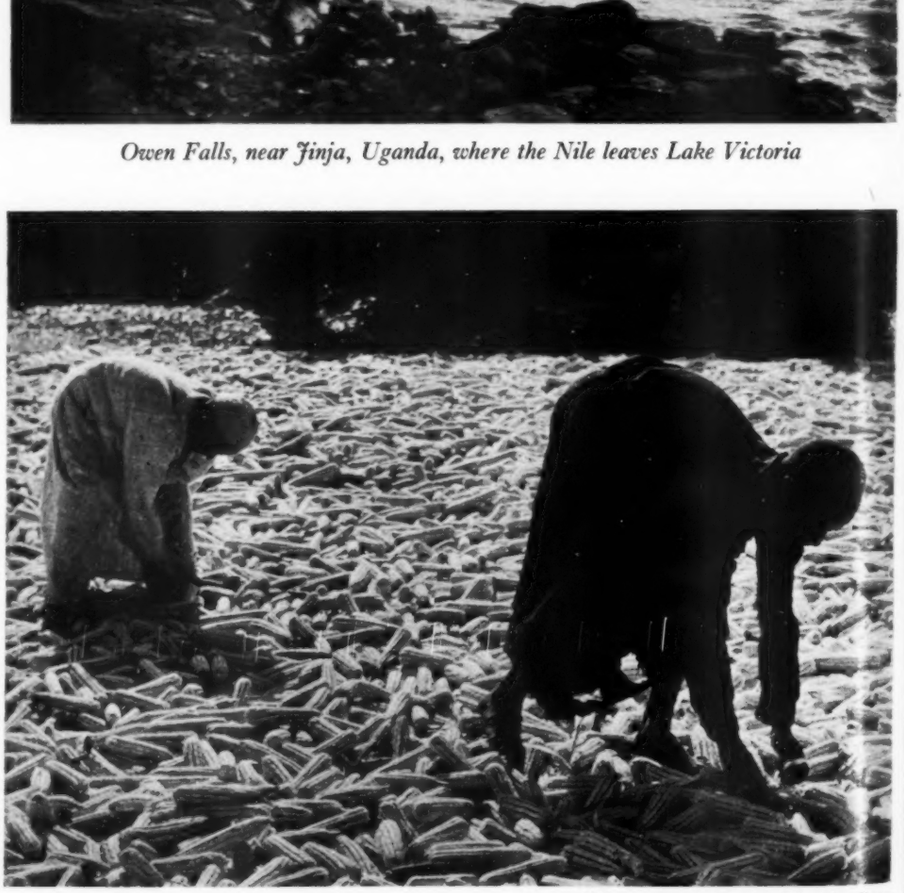
But obtaining a sufficiency of water is not the only problem connected with the growing of crops in Egypt. With the development of perennial irrigation the drainage problem has become acute. The more or less continuous flow gives the land no respite and surplus water finds difficulty in getting away. The level of the underground water table is raised and in places this has become a serious menace. During the last 15 to 20 years several large collector drains have been dug in the north of the Delta and a E£5,000,000 project to install electric pumps at their mouths for lifting the water into lakes has been suggested. Some of the collector drains have reached gigantic proportions, but one of the greatest weaknesses remains the inadequacy of the field drains, since to expropriate land for discharging the water into the main collectors is costly. Another problem involved is that of keeping the drains clear of weeds.

Thus the more water that is used the greater will be the problem of this subsoil drainage, and it is a problem that will demand close attention.

For the most part Upper Egypt presents as yet no difficulty, but a start has been made in providing perennially irrigated areas with effective drainage.



Owen Falls, near Jinja, Uganda, where the Nile leaves Lake Victoria



[*Photo: courtesy Egyptian Education Bureau*

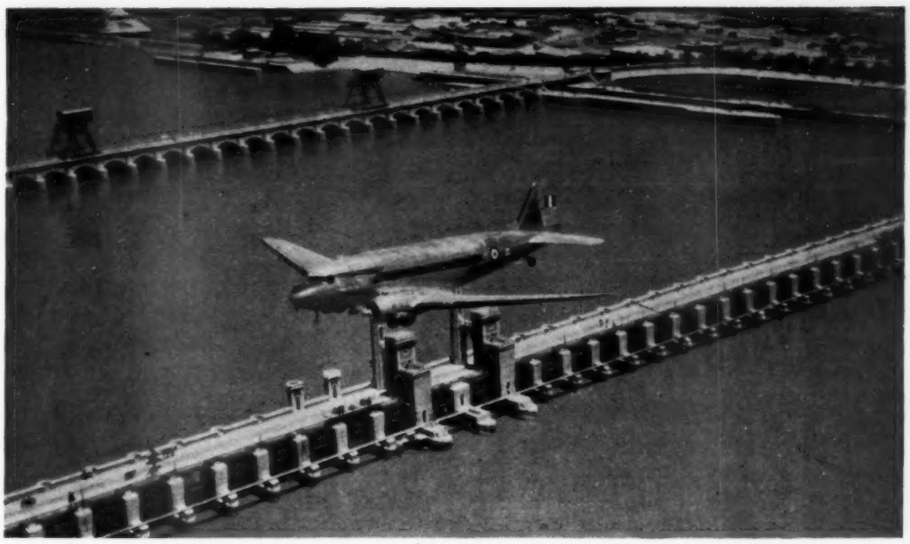
Corn in Egypt

. . . and a possible solution

One of the solutions suggested for those areas which are suffering from rising subsoil water has been the use of pumped subsoil water for summer irrigation. This would rid the land of excess water and would act as a substitute for drainage. Under such a scheme tobacco, jute, millet, peanuts, sesame and cow-peas could be grown, but not cotton. If this were adopted in certain areas the use of electricity for pumping would again provide a great economy over the power at present available.

[*Photo: courtesy Egyptian Education Bureau*

A Dakota flying over the Nile barrage just south of Cairo



New Drive Against the Locust

INTERNATIONAL CONFERENCE IN PAKISTAN

AT the invitation of the Pakistan Government, locust experts from the United Kingdom, India, Pakistan, France, Persia, Egypt and East Africa have met at Karachi to discuss the renewed menace of the desert locust. Dr. Uvarov, director of the Anti-Locust Research Centre in London, which serves as a centre for research and for the collection and dissemination of information, reports and forecasts, attended the meeting.

Reports indicate the presence of increased locust swarms in Arabia, Pakistan, India and French West Africa, which may denote the beginning of a new widespread locust plague. A detailed programme has been drawn up for immediate operation on a large scale and a wide measure of international co-operation achieved. The conference adjourned with the hope that the new locust plague may yet be suppressed in its initial stages.

Recommendations of the conference

Experts at the Karachi conference made the following recommendations:

(1) Anti-locust measures should be strengthened immediately and provision made to introduce modern control methods in the desert regions where monsoon breeding takes place.

(2) The organisation in Pakistan for giving warning and controlling locusts should maintain its efforts and assist in measures to control locusts in the Oman.

(3) As southern coastal areas of Persia are a well-known transit route for locust swarms, the Persian Locust Organisation should ensure close inspection there and on the Island of Gishm. The Bampur basin and Seistan depression should be investigated by technical missions.

(4) The French Government should ensure that constant surveys and control are carried out in French West and Equatorial Africa on the lines adopted by other countries.

(5) Dusting, spraying and baiting are recommended as the best methods of destroying locusts. The use of poisons (especially arsenical compounds which are dangerous to domestic animals) should be abandoned in favour of modern insecticides such as benzine hexachloride.

(6) Military assistance should be made available, where practicable, to support anti-locust organisations.

(7) Oman is regarded as a crucial area for the next campaign, and the safety of surrounding territories must be ensured by large-scale operations.

(8) In the Oman campaign, Pakistan should supply equipment and three field officers with local experience. India and Persia should also supply two vehicles. In addition, these three countries should each contribute £1,500 to a fund to provide dusting machinery and camel transport. The fund would be administered by the Anti-Locust Organisation of Pakistan.

Areas of operation

Detailed plans were prepared for immediate action in Oman (eastern Arabia), where the breeding of locusts during this winter is feared, and were put into practice and supported financially by the countries concerned.

The Pakistani team has already arrived at Sharja on the Persian Gulf, which will be the base for the campaign.

Danger areas in Arabia, the Sudan, Somaliland and Eritrea are being constantly patrolled by motorised teams of the Desert Locust Survey, a British organisation based on Nairobi. The Egyptian Government also maintains a mobile team in Saudi Arabia.

Breeding and multiplication

Gregarious breeding of locusts has resulted from their increased activity in Arabia, Pakistan, India and French West Africa. Locust swarms produced in Oman in the spring appear to have been the source of monsoon breeding in India and Pakistan. Two monsoon generations have bred in India. Swarms that appeared independently in the French Sudan in June had later bred in Morocco in September.

Future meetings

It is hoped that the next meeting will be held at New Delhi in October and that similar conferences will be held annually, to which organisations from countries engaged on locust control will be invited to send their representatives.

Water Utilisation by Crops and the Ability of Soils to Supply Water to Them

E. W. RUSSELL

Department of Agriculture, University of Oxford

It is well known that the three requirements for seed germination are air, warmth and moisture, and that throughout plant life this trinity will, to a very great extent, govern growth and development. In this article the last named of the three is discussed in relation to the crop, the soil and the weather. The part that water plays in plant physiology is a fascinating one and much has been written on such a wide subject, covering water as a carrier of salts in solution, as a transporter of waste products, as a temperature leveller, and so on. Here the author explains the factors affecting transpiration, root intakes and water movement generally, and shows that their practical application when dealing with crops and cropping conditions can be of great use.

ONE of the fundamental problems in all areas liable to drought concerns the ways of making the most efficient use of the limited amount of water available. Recent work has provided a better foundation for our theories than we have had before, and it is now possible to forecast more accurately than hitherto the effect of changes in cropping system on the total water demands.

Transpiration and the factors affecting it

It has long been known that the process of transpiration of water from plants involves the evaporation of liquid water inside the stomata of the leaves, followed by the diffusion of this water vapour through the stomatal openings into the air, for the rate of evaporation of water from a plant with all its stomata closed is very much less than when its stomata are open. The rate of transpiration depends on three factors: the energy absorbed by the leaf, which produces the water vapour inside the stomata; the rate of diffusion of the water vapour from inside the stomata into the atmosphere, which depends on the difference of vapour pressures within and without the stomata; and finally the rate of mixing of this water vapour with the body of the atmosphere, which depends on the turbulence or the windiness of the atmosphere round the leaf. Dry air on a hot day gives a large vapour-pressure difference; moist air on a cool day a low difference; and the water vapour that diffuses out of the stomata gets mixed with the atmosphere much more quickly on a windy day than a still one. Hence hot drying winds encourage and still humid days discourage evaporation.

The relation between the amount of solar energy which falls on a leaf and the rate of production of water vapour is probably reasonably well understood. Plant leaves absorb much of the energy falling on them, and get rid of this energy by two main processes. One part is used to evaporate water in the stomata, for every gramme of water evaporated needs nearly 600 calories of heat. The other part is re-radiated as long heat waves, the amount so lost increasing both as the temperature of the leaf increases and as the atmosphere becomes clearer and drier. Dry clear air is nearly transparent to heat waves, but moist air and clouds absorb them strongly, and re-radiate the energy they absorb in all directions, including back towards the earth. Moist air and clouds thus act as a blanket, almost complete in the case of clouds, to this re-radiation of energy and hence reduce very considerably the amount lost by this process. It is important to note that the proportion of absorbed energy used in photosynthesis is only about $\frac{1}{2}\%$, so is negligible compared with the other two processes.

Meteorological conditions

The hypothesis being tested at the present time, which so far seems to fit all the facts satisfactorily, is that these are the only two processes by which actively growing plants can lose appreciable proportions of the heat they absorb. This is equivalent to the hypothesis that transpiration of water is the mechanism by which leaves can get rid of any unwanted energy they absorb. For the leaves of an actively growing plant exposed to a hot sun differ from the surface of a bare, dry soil in this important respect—they are much cooler, and whilst the hot dry soil will warm up the air in contact with it very considerably, the transpiring plant leaf will not.

Dr. H. L. Penman at Rothamsted, who has been developing this hypothesis, has shown that by its use it should be possible to calculate the amount of water transpired by an actively growing crop from meteorological data only, and thus to calculate the amount transpired per day or per week when the times during the day and night that the leaf stomata are open is known. Unfortunately, these calculations cannot be made very exactly because not enough is known either about the physics of the atmosphere for an accurate estimate to be made of the blanketing effect of moist air in reducing the loss of the energy re-radiated by the plant into space, or about the period in the day that the stomata in the leaves of different plants are open. On this latter point, if the sun is not too hot, the stomata of most crop plants are open throughout the period of bright daylight, closing in the evening before dusk and opening in the morning after dawn.

This hypothesis has also another important consequence. If the land is covered with a crop, so that all the soil is shaded from the direct rays of the sun, the amount of water transpired by an actively growing crop is almost independent of the crop growth, or how fast it is growing. Thus, in a given climate, a pasture, an arable crop and a forest will all transpire about the same amount of water, if the stomata in their leaves are open for the same periods of the day.

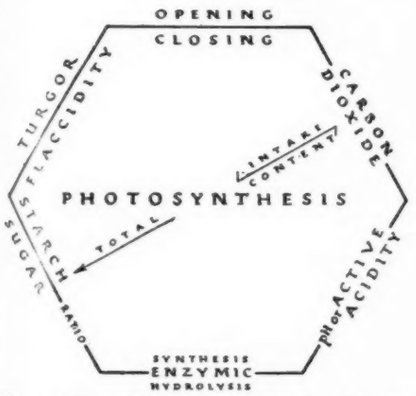
The amounts of water transpired by a crop calculated in this way can be compared

with the transpirations measured over considerable areas of land. Hydrologists and water supply engineers have often estimated the amount of water lost from catchment areas by vegetation. The amount of rain falling on the area and the amount of water leaving in the river can each be measured approximately, and in catchment areas where there is no net outflow in ground-water, the difference gives the amount of water lost by transpiration. There are not many catchment areas for which all the necessary data are available, but for those so far examined, the observed losses are of the same order, that is to within 1 to 2 in. of those calculated by Penman.

The actual magnitude of these transpiration losses for crops growing throughout the year, such as pastures, is about 18 to 20 in. of water in the south-east of England, and rises up to 5 to 6 ft. in equatorial swamps. In normal subtropical practice it is about 3 to 4 ft. In England, about two thirds of the annual loss occurs in the four summer months of May-August.

Seasonal growth

The obvious practical consequences to be drawn from this hypothesis are all in accord with field experience. Thus in semi-arid regions having a pronounced hot and cold season, much more efficient use is made of the limited amount of water available by cultivating crops which make most of their growth in the cool season and merely mature in the hot. Thus in the typical semi-arid wheat areas of the world, wheat makes most of its growth in the spring, when the temperature and therefore the transpiration per day is fairly low; and it is maturing and making little new growth, so needing to transpire little water, during the heat of the summer, when a growing crop would need to use very large amounts of water. It therefore follows that in such climates, early maturing crops such as wheat can succeed under conditions where perennial crops like pastures would fail, because an actively growing pasture would use no more water per day than the wheat in the spring, but would have to use much more per day in the summer when the wheat is finished, if it is to keep growing.

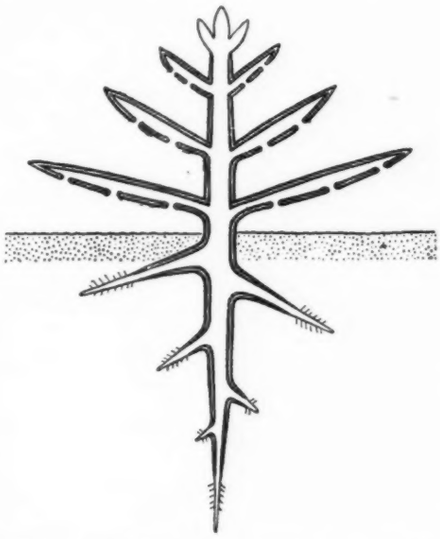


[From J. Small and co-workers, Proc. Roy. Soc., Edin., 1942

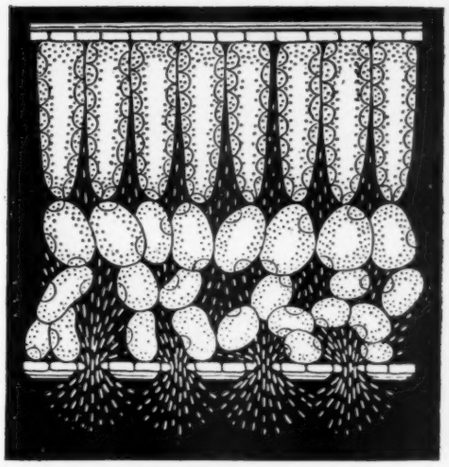
The mechanism of stomatal movement

Root depth and water consumption

Again the amount of water needed by a growing crop hardly depends on how much growth the crop is making—a starved crop uses as much as a well-manured one, provided it is covering the ground completely and it remains green. This was shown very clearly at Rothamsted 80 years ago in the great drought of 1870. On the permanent hay field—Park Grass—the unmanured plot only gave a yield of 6 cwt. per acre, which was a quarter of its normal yield, whilst a plot receiving a heavy dressing of sodium nitrate and complete minerals yielded 56 cwt. per acre, which was about its normal yield. The two plots received the same amount of rain, which was 3 in. in the previous three months, and the grass had taken almost the same amount of water from the soil, about 3 in. on the unmanured and 4 in. from the well manured, giving total transpirations of about 6 and 7 in. respectively. And the reason the well-manured used more water was that its roots went down about 9 in. deeper, taking some water from the layer 27 to 36 in. deep, whilst the root system of the unmanured crop could not take water from below the 18 to 27 in. depth, presumably because it was too starved to make the extra growth.



The whole plant is enclosed in a cuticle except for the youngest portion of the shoot, the stomatal guard cells and the absorbing region of the root



Vertical section of leaf to show gradient of diffusion of water vapour when outer air is drier than the air of the intercellular spaces

Water shortage and wilting

The discussion so far has been confined to crops adequately supplied with water, so their stomata remained open during the day. Once water shortage sets in, or once potential transpiration during the heat of the day exceeds the rate that the plant can supply water to the leaves, the stomata will close when the moisture content of the leaf has fallen below a certain level. The transpiration will in consequence be very much reduced, so that, in consequence, the temperature of the leaves will start to rise and it may rise sufficiently to kill the cells in many kinds of leaves. However, some leaves can partially protect themselves from this rise in temperature by wilting, that is by folding themselves up and so exposing a smaller surface to the sun and hence absorbing less energy.

It is now possible to appreciate one of the important differences between drought-resistant and drought-sensitive crops. A drought-resistant crop such as a sorghum does not necessarily use any less water per day than a drought-sensitive crop when both are adequately supplied with water. The essential difference is that the leaves of a drought-resistant crop do not suffer when all their stomata are closed, because of water shortage, and their temperature rises, whereas the leaves of the drought-sensitive crop may be killed under these conditions. Drought-resistance is not, in fact, ability to grow with very little water, but ability to withstand high leaf temperatures without serious consequences. These remarks, however, only apply to normal agricultural crops and may not apply to highly specialised desert plants such as the cacti and other xerophytes, but, on the other hand, these plants rarely ever grow so thick that they can completely cover the soil.

Ability of crops to extract water from the soil

The second group of problems of importance in discussing the relation between water and plant growth concerns the amount of water a crop can extract from the soil, and this depends on the soil, the ability of the crop to extract water from each cubic foot of soil, and the depth and ramification of the root system, that is on the total volume of soil from which the plant roots can extract water. Plants differ among themselves considerably in these respects: thus maize and potatoes can extract less water from a cubic foot of soil than can wheat, so in semi-arid climates more water is left in the surface layers of a soil after a maize crop than after wheat.

This can be seen in the following table, which gives the yield of wheat following certain crops at Lacombe Alberta, a region in which the adequacy of the water supply in the soil is usually the principal factor controlling the yield.

EFFECT OF PRECEDING CROP ON YIELD OF WHEAT IN SEMI-ARID REGIONS (THREE YEARS' AVERAGE)

Preceding crop	*Yield per acre*	*Yield of wheat in bushels per acre*
Fallow	—	38.2
Maize (cut green)	8.7 tons	34.6
Potatoes	6.0 tons	29.8
Lucerne	1.4 tons	23.6
Wheat	33.7 bu.	22.7
Grass ley	2.0 tons	21.8

Lucerne can be much deeper rooting than wheat, so that in semi-arid climates a crop of lucerne may dry out a soil to a much greater depth than can a wheat crop. This may be a great disadvantage in areas where the total rainfall is low, but an advantage where it is moderate but badly distributed; for the lucerne, by drying out the soil to a considerable depth in a dry season, will allow it to hold more water when the rains begin and will protect the soil surface against erosion, thus delaying run-off.

Rooting and soil texture

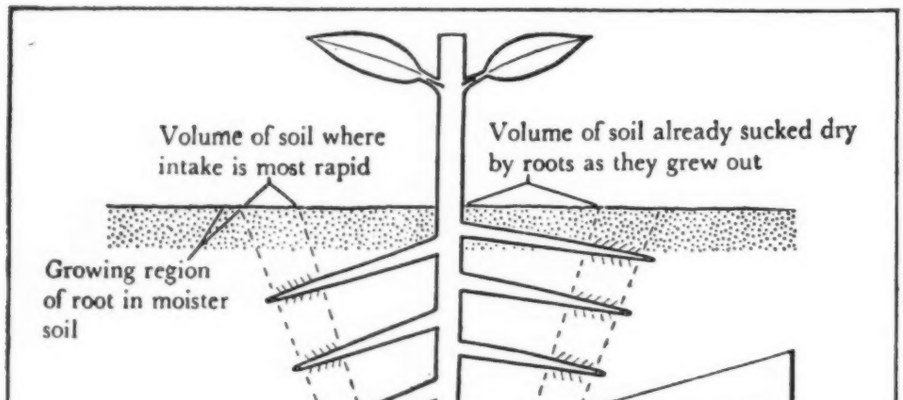
On the whole the factor of most importance in determining the amount of water different crops can extract from a given soil is the depth to which the root system penetrates, though in heavy soils the thoroughness with which it ramifies through the soil in the root zone is also important. Normally these two properties of the root system are dependent on the species and variety of crop grown, and can only be altered to a comparatively small extent by soil management. Plants growing on adequately manured and well-drained soils, which have no zones in which reducing conditions occur for any appreciable part of the year, tend to be able to develop a deeper and a more ramifying root system than when growing on badly-drained soils or soils short of plant nutrients. Again, anything one can do to encourage a heavy clay soil to develop an extensive system of fine cracks helps the root system of a crop to ramify through the soil. In general, the only way this can be done is to include in the rotation a very strong rooting crop which will cause the soil to crack extensively in the dry season, and if these cracks persist, the root system of a weaker rooting succeeding crop can ramify through them. Sometimes, however, deep cultivation encourages the root system of a crop to become more branched in clay soils, and this can be done either by using a subsoiler or a deep plough, though the latter is usually the more efficient method as it allows the good-structured crumbly surface soil to be put into the bottom of the furrow and the badly-structured subsoil to weather down on the surface. But the value of this practice on some of the tropical and subtropical clays does not seem to have been extensively investigated.

Water holding powers

There is very little that can be done to increase the amount of water that a cubic foot of a well-drained soil can hold, for it appears never to be good practice to allow a soil to store water for a crop by waterlogging it. Adding organic matter helps, but it is probable that one must add considerable quantities over a number of years before the amount of water held by the soil that is available to, or extractable by, the plant roots is increased appreciably. Thus in the cool climate of Rothamsted, adding 14 tons per acre of farmyard manure almost every year for a century has increased the amount of available water held on Broadbalk by about $\frac{3}{4}$ in., and this is all held in the ploughed layer. This soil holds about 2 in. of water per foot in the subsoil, so that the effect of adding all this organic matter corresponds to deepening the root zone of the crop by 4 to 6 in. The point of practical importance, however, is that since this additional water is near the soil surface, a proportion of it is available to the small and restricted root system of the young crop, and the reason that only a proportion usually is so available is that this soil can lose more water from the surface by evaporation than the soil which has not received the farmyard manure, as it holds more.

Capillary movement

Plants can extract some water from the soil below the depths to which their root system penetrates, and Penman at Rot-


Volume of soil where intake is most rapid
Volume of soil already sucked dry by roots as they grew out
Growing region of root in moister soil
Water also moves up from lower levels

[The diagrams used to illustrate this article are all reproduced from Alexander Nelson's 'Principles of Agricultural Botany,' by kind permission of the publishers, Thomas Nelson and Sons, Ltd.

Diagram showing plant soil relationship with reference to water supply

hamsted has shown that for several English soils the amount of water that can move up into the root zone from below by capillarity is about 1 in. This work of his has put the capillary movement theory of water on a firm quantitative basis. It has long been known that water cannot move over long distances by capillarity, and there was a widespread belief that this fact proved that the capillary theory of water in soils was wrong. In fact, it has always been recognised that water could move short distances by capillarity, but the magnitude of the effect was long in doubt. It now appears that water can only move in a well-drained soil through distances of the order of 9 to 12 in. at a rate sufficiently fast to be of any use to the plant, and the total amount that can move out of this zone before movement becomes so slow as to be of little practical importance, appears to be about 1 in. Since a crop may transpire water at the rate greater than 1 in. per week in dry, sunny weather, the role of capillarity is only minor, and the statement is still true that, in the main, plant roots must go to the water in the soil rather than the soil water move through the soil to the roots.

Conclusions

Transpiration of water by plants is increasingly being looked upon as the mechanism by which actively-growing plants can get rid of the unwanted solar energy they absorb without the temperature of their leaves having to rise. This is in accord with the field observations that the amount of water used per acre of crop growing in moist soil is much more dependent on the meteorological conditions prevailing over the crop than on the crop itself. Further, the principal reason that there is any dependence on the crop appears to be due to the variations that exist between the periods of the day when the stomata in the leaves are open.

The outlook emphasises that the problems of drought resistance are in the main those of drought avoidance. Drought-resistant crops do not use less water than drought-sensitive crops, but they can withstand their leaves becoming very hot without permanent damage.

There is very little one can do to increase the amount of water a soil can hold that is available to the crop. Far the most important way of allowing crops to extract more water from a soil is not to increase the soil's water-holding power but to increase the depth of rooting of the crop, or, if the soil is heavy, the intensity with which the root system can ramify through the clay.

Agriculture in the Belgian Congo

BELGIUM, a late-comer among colonial powers, has in the last few years sprung into the front rank in the scientific development of agriculture. Nobody nowadays can speak with authority on tropical agriculture who is ignorant of the work achieved in the Belgian Congo. The publication of a ten-year plan of economic development for the Congo, with 100 pages in the second volume devoted solely to agriculture, is therefore of considerable interest to British readers.* The 33 maps and 52 tables of appended statistics which are supplied with the text alone make it a valuable work of reference.

This is a plan of development for the decade 1950-59, to be financed partly from Congolese, partly from Belgian metropolitan resources and partly also, it is hoped, by attracting foreign capital. How does it compare on the agricultural side with the similar ten-year plans which have been issued by many British colonies? The first thing that strikes one is the thoroughgoing logic of the Gallic approach. On p. 19, for example, it is calculated that a population of 11 millions in the Congo have an average weight of 40 kg. each and will therefore need for their nutrition 160,600 tons (metric) of protein a year; from which premise the plan proceeds to work out how that quantity of protein can be made available. The anonymous authors can, nevertheless, be non-committal when they want to be. If one turns to the section on cinchona to see what the prospects for quinine are thought to be, one merely finds a calculation of what the total production will be when all the areas now planted have yielded a crop. It is the same with tea. After some discussion of market prospects, it is merely stated that the I.N.E.A.C. will open an experimental station for it.

In general, however, the plan envisages very great increases in crop production. All the ordinary native-grown crops, with the exception of bananas, have much increased target figures set them for 1959, the highest being for groundnuts with an increase to 292% of the 1947 production. The jute substitutes, *Urena lobata* and *Cephalonema polyandrum*, with which the Congo has been experimenting for many years, are considered to justify an increase

**Plan Decennal pour le Developpement Economique et Social du Congo Belge.* Two vols. Les Editions de Visscher, Brussels, 1949.

in production from 11,000 to 24,000 tons. On the other hand, the possibilities for tobacco seem to be under-estimated, since it is merely stated that production for sale could be increased fairly quickly to 1,500 to 2,000 tons, whereas in the past imports of cigarettes into the Congo have been rising steadily, and amounted in 1948 to 2,355 tons.

The Belgians also have felt the necessity to provide bulk storage for grain. The plan proposes two big silos at Leopoldville, one for cereals and one for oilseeds, with a capacity of 10,000 tons each; and three silos along the railway in Kasai Province. The planners have had to answer the old question as to whether specialist staff should be appointed for soil conservation work, or whether these duties should be regarded as part of the normal work of every agricultural officer. In this they seem to have compromised, since the plan proposes the employment of an Anti-Erosion Mission with a European staff of 37 during the decade, but only to work in the two districts of Kivu and Ituri.

The most startling proposal in the plan is certainly the scale on which it is hoped to settle peasants on defined holdings (lotissements) during the decade. The Belgians have, of course, already had considerable experience with their 'corridor' settlement schemes; and it seems to be implicit that a recommendation as to the system of cropping to be followed will be part of the settlement work in each area. The size of holdings favoured is given as about 9 hectares in forest areas and 7 hectares in savannah country. The truly ambitious target is set of settling one fifth of all the peasant farmers by 1959.

Among points which will strike British readers of this plan is the absence of any great hopes from mechanisation, on which no more than an experimental programme is proposed. Their envy will be aroused by the scale on which it is intended to engage scientific staff; new recruitment will include 27 qualified agronomists and 187 European agricultural assistants for the agricultural field service alone, apart from the research services of I.N.E.A.C. Expenditure is budgeted for building 333 houses for European agricultural staff during the decade.

The general impression will probably be formed that the figures for the course of agricultural development are too cut-and-dried, and do not allow of enough flexibility. On the other hand, the opposite criticism may also be made that some of the target figures do not represent any real planning at all, since they have been arrived at merely by extrapolations from the curves of agricultural production over the past years. G.B.M.

India's Cashew Harvest Smaller

INDIAN cashew production in 1949 has been placed at 38,900 short tons, unshelled basis, compared with 51,000 tons (revised) in 1948 and 26,900 tons in 1947. The estimate is 20% below the ten-year (1938-47) average of 48,700 tons and 17% below the five-year (1943-47) average of 46,600 tons. These estimates include production in Portuguese Goa. The estimates are for Indian production of cashews only and do not include imports from East Africa.

Forecasting difficulties

The cashew tree grows wild in many parts of India and there are very few commercial plantings. The nature of the industry makes it extremely difficult even under the most favourable conditions to forecast or estimate production accurately. In addition to being a wild crop, there are three crops a year and this fact further complicates estimating the size of the harvest. The first blossoms appear in December and the fruit is ready for harvest in February. The first crop usually yields about 50% of the year's harvest. The second blossom takes place in February and the fruit is ready for harvest about April. The second blossom usually produces about 35% of the harvest. The final blossoming occurs in April and produces fruit in June which makes up about 15% of the year's harvest. During 1949, the first two blossoming periods took place under drought conditions which greatly reduced the crop. The third blossom benefited from late rains and turned out to be considerably larger than had been anticipated. The Indian-produced nuts are estimated to have produced about 9,700 short tons of kernels.

Imports and exports

The importation of African unshelled cashews during 1949 are said to have totalled about 56,000 short tons or the equivalent of 26,400 tons of kernels. The total available supply of cashew kernels during 1949 in India, therefore, was about 36,100 short tons. There was no carry-over from the 1948 crop. Exports from January to August totalled about 12,300 short tons and before the end of the year totalled about 19,000 tons. Consumption in India, mostly off-grades, will take the balance of the estimated supply and no carry-over into 1950 is anticipated. The imports of cashews from East Africa are expected to be the largest on record. The African crop was large, while the Indian crop was below average. Portuguese East Africa supplied a total of 35,753 tons of unshelled cashews to India during the first half of 1949.

It was estimated that on October 1 the available supply of cashew kernels for export in India totalled about 5,600 short tons. According to Indian statistics, exports during the first half of 1949 from south India totalled 8,292 short tons, of which 7,465 tons were to the United States, 409 tons to Mexico, 196 tons to Canada and the balance to various other countries. Bombay during the same period exported 165 tons, of which 66 tons were to Pakistan, 47 tons to Hong Kong and 34 tons to the United States.

Future developments

The outlook for the remainder of this season and for the 1950 season is a little confusing at this time. Devaluation of various currencies in September resulted in a higher price of African cashews in terms of Indian rupees. There was a rumour early in October that an export duty would be assessed by the Indian Government on export of cashews to the United States and this caused some importers of African nuts to hold back on normal purchases in Africa for this year's operations. In addition, another rumour was heard on the Bombay market that a United States' firm planned to purchase about 33,600 short tons of unshelled cashew nuts in Portuguese East Africa to extract shell oil. Exporters believe that the American firm probably will destroy the kernels in the process, thus reducing the available 1950 supply of edible kernels by 8,400 short tons. It is reported that a British firm has constructed an oil mill for the crushing of cashew nuts in British East Africa and may process the nuts purchased by the American company.

If the weather and growing conditions in India from December 1949 to June 1950 are favourable a normal cashew crop is expected, which would offset to some extent the loss of African nuts reported sold to the American firm. It is generally believed by exporters that cashew kernels during the present season and possibly into 1951 will be slightly higher priced than before devaluation. There is some reason to believe Indian importers of African nuts will refuse to buy until prices decline to more realistic levels. A government export duty, if levied, will cause still higher prices.

East African production is, however, understood to be expanding and provided prices do not rise too steeply there should be openings for increased consumption not only in the Indian markets but also elsewhere.

[Photo: courtesy of the United Africa Co. Ltd.

Surf-boats at Accra loaded with cocoa for transhipment to sea-going vessels

The West African Farmer and World Markets

W. L. BLOOMFIELD

Assistant Managing Director, Nigerian Produce Marketing Company

A major difficulty of agriculture in the past has been the enormous fluctuations in world prices for produce. The developments which have occurred in British West Africa during and since the war which have led to the establishment of official marketing and price control boards for a wide range of agricultural produce are advances of major importance. The following paper, recently read before the Royal Society of Arts and abridged from the journal of the society, provides a succinct and comprehensive account of the history and scope of these organisations. It is of particular interest since these developments may conceivably provide a pattern which could in due time influence the whole course of world trade in agricultural commodities.

NEW marketing organisations have recently been created in West Africa to assist the farmer in marketing his produce overseas. However, before the possibilities of these organisations can be assessed or their difficulties appreciated, something of the background out of which they grew must be understood.

First, the territories themselves. Nigeria, the largest, exports groundnuts, palm kernels, palm oil, benniseed, hides, skins and cotton. Next in size, the Gold Coast, relies mainly on cocoa; followed by Sierra Leone where palm kernels predominate; and the Gambia, a small territory which exports only groundnuts. Together these territories provide more than half the world's supply of cocoa beans, the raw materials for more than 40% of Britain's margarine and cooking-fat ration, over 50% of its soap ration and large quantities of oilcake for cattle feeding.

The farmers are mainly peasants working their own farms or collecting fruit from the communal village palm trees, except in the Gold Coast where labour is hired to help harvest the cocoa crop and where farms are occasionally run by wealthy absentee landlords. However, wherever the farmers are they have this in common—they are all Africans. There are no European farms or plantations in West Africa, except a very few relatively small plantations operated by the United Africa Co., which account for less than 1% of the total production.

Marketing the produce of W. Africa

The cocoa or groundnut farm is seldom more than an acre or two, and often less, and here the farmer will also grow his food crops of yams, maize, cassava or plantains in the forests, or guinea corn and millet in the dry inland areas. It is difficult to call the oil palms part of a farm, as they are the indigenous forest, the trees round a village being communally owned by the villagers. Cultivation is carried out mainly by hand, although a few ploughs are now in use in groundnut growing. Harvesting and preparation for market is a relatively simple matter, except in palm-oil production, where the fruit has to be sterilised soon after picking. Where this is done, as it is in the plantations of the Belgian Congo, Malaya and the Dutch East Indies, and the oil extracted mechanically, a high yield of good quality oil is obtained which is suitable for edible use even after shipping to Europe. With primitive methods of extraction, however, yields are low and the quality not up to edible standard. Hand presses have been introduced into Nigeria to assist in the extraction, and recently the government have erected a few small extracting plants which give a good yield and produce an edible oil. These extracting plants have proved so successful that many more are now on order. The palm fruit also contains kernels which produce an oil with characteristics similar to those of coconut oil. Each year millions of these nuts are cracked individually between two stones by the African women and children. The kernels, after drying, are collected, and reach the ports to be shipped at the rate of 400,000 tons of kernels a year.

Pre-war organisation

The main link between the farmer and the world market is the merchant, who before the war purchased the produce in West Africa and sold it to a manufacturer, either direct or through a broker or dealer operating in one of the international commodity markets. In the early days all trade was carried on by barter.

Between the merchant and the farmer come a whole host of African and Syrian middlemen, factors and brokers. A few use their own capital, but mainly they use money advanced by the merchants. Despite all the middlemen, the farmer can, and often does, sell his produce direct to the local branch of the merchant firm. In addition, in the cocoa areas there are strong producer co-operative societies which, before the war, sold their cocoa direct to the merchant.

The last partner in this produce trade is the government, which provides technical service and advice, carries on research and field work through the agricultural departments, and organises a produce-inspection service to protect the name of the territories' produce in the world's markets by ensuring that only properly prepared and unadulterated produce is exported.

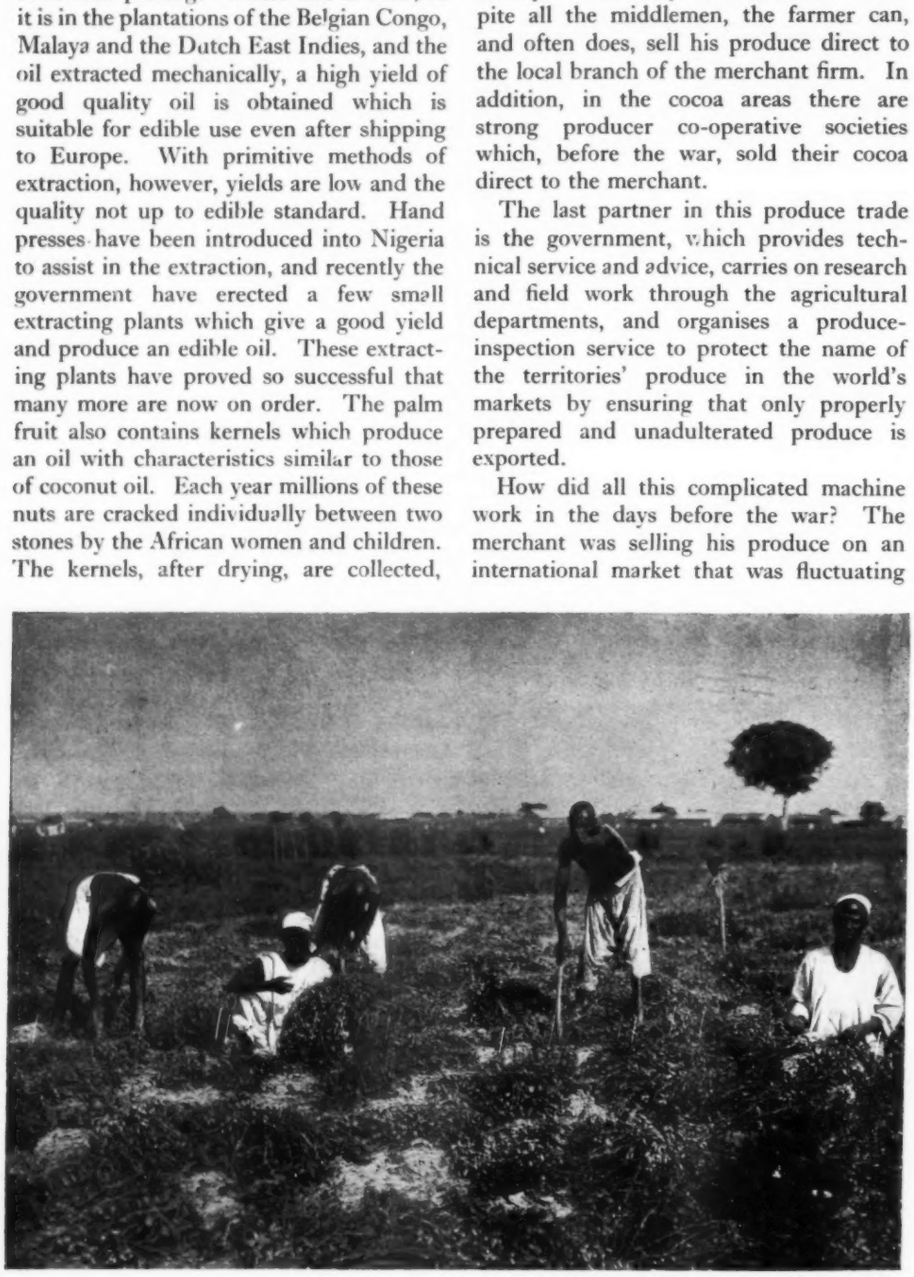
How did all this complicated machine work in the days before the war? The merchant was selling his produce on an international market that was fluctuating from day to day. Competition to purchase produce was so intense between various firms in the trade that the merchant had to pay in the main African centres the full equivalent of the current London price and even more, so that it was only by speculating that he could hope to make a profit on this trading. The scramble for tonnage, particularly in cocoa — arising partly from a desire to cut down overheads per ton and partly for prestige—led to the offer of ever increasing inducements to middlemen, the granting of excessive cash advances and even connivance in malpractices.

In 1938, following the cocoa boom of the previous year when prices had fluctuated wildly, the firms decided to form a pool to regularise the trade and put it on a sound basis which would provide a small but fairly sure profit, in place of the previous alternating visions of opulence or bankruptcy.

The agreement, which was signed by all the established cocoa merchants except the C.W.S., was drawn up in good faith, and looking at it now it seems a reasonable scheme except that there was no provision for the actions of the pool to be supervised by any official body. However, the introduction of the pool coincided with a substantial fall in the world cocoa price; that sealed its fate. The whole of the Gold Coast rose up in arms, and the farmers, aided and encouraged by their chiefs, refused to sell their cocoa. A commission was appointed to examine and report on this state of affairs and to recommend a system of marketing which would avoid its recurrence. The commission reported that the existing marketing arrangements were unsatisfactory and recommended that a Cocoa Growers' Association should be set up and governed by a board consisting of officials, African representatives and one or two independent co-opted members. The Association, which was to be the sole seller of cocoa, would be organised in groups and regions under regional managers who were to organise transport and storage. The Association was to have the right to sell direct on to the world market, but the intention was that the normal method of selling should be to the West African merchants for delivery at the up-country regional centres. The proceeds of the sales of each area were to be divided periodically, say every two or three weeks, amongst the farmers who delivered cocoa.

War-time organisation

Eventually the pooling agreement was abandoned and the hold-up ended. Cocoa moved regularly next season, but it was felt that all was not well with the cocoa



[*Photo: courtesy of the United Africa Co. Ltd.*

Harvesting groundnuts

trade—or for that matter with the West African produce trade in general. However, before His Majesty's Government had time to act upon the recommendations of the commission, war broke out. Knowing that it would be impossible to sell the whole cocoa crop through the usual channels, His Majesty's Government undertook the purchase of it. After a year of control by the Ministry of Food, the Colonial Office took over responsibility and set up the West African Cocoa Control Board to purchase the crop and dispose of as much of it as possible. At the same time the government announced its intention on the one hand to bear any eventual loss on resale and, on the other hand, to invite Parliament to vote a sum equivalent to any eventual profit realised, for payment directly to the producers or, in agreement with the colonial governments concerned, forexpenditure on objects of benefit to them.

The position with oilseeds was different. After the fall of the Far Eastern territories, West African palm oil and oilseeds became vital to the prosecution of the war. At first the Ministry of Food purchased the whole crop through the West African merchants, but it soon became apparent that if maximum production was to be pursued, some new body with a closer link to the colonies would have to be set up. The Cocoa Board, with its knowledge of West African trade, was the obvious choice. The Board changed its name to the West African Produce Control Board and became sole purchaser of almost the whole of the exportable surplus of British West African agricultural produce.

One of the first duties of the Board was to agree with the West African governments on the prices to be paid to the farmer. As world markets and free competition had disappeared, these were fixed with the object of encouraging maximum oilseed production on the one hand and keeping the cocoa farms on care and maintenance basis on the other. The price so fixed remained unchanged for a season, so that the groundnut farmer knew what price per ton he would receive for his crop before he had planted it, and the cocoa farmer or palm producer knew at the beginning of the harvest what he would receive for his crop. Thus the farmer was no longer left to wonder whether the middleman was giving him a square deal or whether he would get more if he kept his produce for another month or two. The middleman, too, could get on with his proper function of collecting and forwarding the produce in return for a reasonable fixed remuneration, instead of spending his energy and ingenuity in attempting to score off farmer and merchant.

[*Photo: courtesy of the United Africa Co. Ltd.*

Sowing groundnuts

The Board left the actual handling of the produce to the merchants who carried on their pre-war functions as buying agents of the Board, remunerated by agreed margins to cover their expenses and profit. As the price to the producer was now fixed, competition between merchants disappeared and buying quotas were agreed. In fact, to some extent the machinery of the old pools came into operation, this time, however, under the supervision of the Board which, incidentally, found it possible in later years to withdraw the quota system and introduce some measure of competition.

The control ran smoothly and, after three or four years, it was decided to publish the results of trading to date, together with a statement as to how it was proposed to deal with the resulting surplus. A substantial surplus had in fact accrued, so discussions were started to decide how this could best be used for the benefit of the farmers. Arguments centred round the two main problems of the West African cocoa trade—the unsatisfactory state of affairs revealed by the report of the Commission on Marketing, and the virus disease, 'swollen shoot.' Attack on disease was rightly given priority and £1,250,000 were allocated to endow the then recently created West African Cocoa Research Institute.

Introduction of marketing boards

It was decided to invite Parliament to vote the remainder of the surplus for financing the formation of a marketing organisation which would insulate the price paid to the farmer from the day-to-day fluctuations of the world market and at the same time protect him from the extreme effects of boom and slump. A White Paper was published suggesting that this could only be achieved by creating Boards in West Africa as the sole exporters of cocoa. This was in line with the commission's recommendations, but its other recommendations were rejected as they did not provide for a stable day-to-day price, which had proved to be such a boon during war-time.

During the following year a further White Paper was issued setting out plans for creating Cocoa Boards in the Gold Coast and in Nigeria, and in 1945 the government voted the surplus money for the creation of Marketing Boards. The legislation creating the Marketing Boards was submitted to, and approved by, the Legislative Councils of the respective territories and the Cocoa Boards commenced operations in October 1947.

Meanwhile, oilseeds continued to be handled by the West African Produce Control Board, but after the war shortage of oils and fats revealed itself in rapidly rising prices. In West Africa prices paid to the farmers were substantially increased, but there was still a considerable gap between these and world prices. The Produce Board, therefore, in 1947 began selling oilseeds to the Ministry of Food at the world price, which allowed it to accumulate a surplus to be set aside for future price stabilisation. After discussion, it was decided that these stabilisation funds should form the initial capital of Oilseed Boards, similar to those already created for cocoa. At the same time, a Cotton Marketing Board was set up in Nigeria, with the assistance of a grant from the Raw Cotton Commission. Boards were not formed until April 1949 in Nigeria, and August in

the other territories. There are now operating in West Africa the following Marketing Boards:

Nigeria Cocoa Marketing Board
Nigeria Oil Palm Produce Marketing Board
Nigeria Groundnut Marketing Board
Nigeria Cotton Marketing Board
Gold Coast Cocoa Marketing Board
Gold Coast Agricultural Products Marketing Board
Sierra Leone Produce Marketing Board
The Gambia Oilseeds Marketing Board.

Together they purchase more than 90% of the exportable surplus of British West African agricultural produce with an annual turnover of just short of 1,500,000 tons. The accumulated surpluses handed over to the Boards by H.M. Government were: Cocoa, £25,000,000; palm oil and oilseeds, £18,000,000.

These Boards carry on the West African Produce Control Board's policy of employing a small headquarters staff, leaving the actual buying and handling of produce to the merchants and the producer co-operative societies, who act as their buying agents and are paid for their services at a flat rate per ton. On the selling side, the four territories have set up a joint office in London, although each territory actually trades through its own subsidiary company.

[*Photo: courtesy of the United Africa Co. Ltd.*

Winnowing groundnuts

Objects of marketing boards

One of the main objects is to give the African a greater opportunity to participate in the marketing of his produce overseas. The existence of statutory Boards with large African representation goes a long way towards achieving this, especially when the members are farmers or come from farming communities.

In Nigeria the four Boards—cocoa, palm produce, groundnuts and cotton—use the same headquarters and staff in Lagos. Each Board has a similar structure of approximately three officials and three Africans. The same officials sit on each Board, the chairman, the Director of Agriculture and the Director of Marketing and Exports, who is also the head of the Boards' executive, but the African members are chosen by the Governor for their business ability and knowledge of the particular crop and district. Behind each Board is an advisory or representative committee consisting predominantly of farmers' representatives. These committees provide channels through which the Boards can test the reactions of the farmers to their policies, and the farmers can pass their ideas on to the Board.

In palm produce and groundnuts there is also provision for three Regional Development Boards to administer funds allocated by the Marketing Boards for development.

The other colonies do not need the complex Nigerian structure, and therefore have only single Boards whose unofficial members are nominated by various bodies representing farming and other interests.

The stable prices and guaranteed market encourage African firms to enter the produce trade as buying agents. Applications are invited from firms wishing to become buying agents, but to ensure that its work is carried out efficiently the Boards lay down certain minimum requirements of storage and finance which a firm must possess before it can be considered. The Boards also have a duty to assist and encourage the producer co-operative societies. The Nigeria Cocoa Board has assisted the co-operative societies to obtain cheaper finance than they had been able to obtain previously, and it has recently loaned them a substantial sum of money to enable them to build stores at ports, the intention being that the loan shall be repaid over a long period. In addition, it encouraged the co-operative societies, who are not yet strong enough to become full buying agents, to build up an organisation by paying them a premium of 10s. per ton for their cocoa.

The basic object of the scheme is stabilisation of prices, of which one aspect is to isolate the price paid to the farmer from the day-to-day fluctuations of the world market, which were the cause of so many difficulties before the war and laid the farmer open to the wiles of the better-informed and more astute broker or middleman. This object has been achieved by carrying on the war-time arrangement of fixing the price to be paid to the farmer at the commencement of harvesting for tree crops and at the time of planting for annual crops, and keeping this price unchanged throughout the season. This price is widely published and exhibited at markets, so that the farmer is given every assistance to see that he gets a square deal. This involves the Boards in the risk of fixing the price they will pay for the crop, which in these difficult times is not an easy matter. Fortunately the reserves of the Boards have enabled them to take this risk.

Another and perhaps more important aspect of stabilisation is the protection of the farmer against the extreme fluctuations in the sale price of his produce. West Africa, being the producer of over 50% of the world's cocoa beans, has to sell her cocoa all over the world and therefore must stand the full blast of changes in the the international market price, which can be extremely violent. Since the U.S.A. removed price ceilings in 1946, the price of cocoa has risen from £50 to £250, fallen again down to £90 and at present is about £170. The following produce prices paid in the Gold Coast during this period show that the policy of the Boards has enabled the price to the producer to follow the market trend while ironing out the more violent fluctuations:

	s. d.
1946-47 ..	27 6 per load of 60 lb.
1947-48 ..	40 0 ,, ,, ,, ,, ,,
1948-49 ..	65 0 ,, ,, ,, ,, ,,
1949-50 ..	45 0 ,, ,, ,, ,, ,,

The Cocoa Boards have already successfully weathered their first difficult period. At the beginning of the 1948-49 season, selling prices were close to the maximum,

and therefore the Boards felt it necessary to increase substantially the price to the farmer for that year. However, during the year selling prices cracked and fell dramatically. Nevertheless, I anticipate that, when the Boards publish their accounts for 1948-49, it will be found that their main funds remain intact and still available to support the price to the farmer when necessary.

So far the Oilseed Boards have been more fortunately placed in this respect, as this country requires all their produce. They have therefore been able to base their stabilisation policy on long-term contracts with the Ministry of Food, which has agreed to purchase the whole of their exportable surplus up to the end of 1952. Provision is made in the agreement for the prices to be fixed anew each year, but limits are set to the extent that they can fluctuate from one year to another. Therefore the contract should enable the Boards to avoid violent price fluctuations during the next few years, and so to emerge at the end of 1952 with their stabilisation reserves intact, or even augmented, and ready to meet whatever lean years may be in store for them. The Cotton Board has a similar arrangement with the Raw Cotton Commission.

Research programmes

Naturally one of the objects of the Boards is to promote research to eradicate disease and assist in rehabilitation. In addition to the £1,250,000 originally set aside for cocoa research, the Cocoa Boards have allocated a further £1,000,000 to the West African Cocoa Research Institute. They have also put aside about £10,000,000 to compensate farmers whose diseased trees have been cut out in order to prevent the spread of swollen shoot disease, and to encourage them to replant.

The Nigeria Oil Palm Produce Board has taken over the financial responsibility for the Palm Oil Research Station in Nigeria, and the Nigeria Cotton Board has appointed a cotton development team to encourage an increase in the acreage planted with cotton as well as to advise in its proper cultivation.

The Boards are also charged with the promotion of the best methods of preparation of produce for market. Getting the African farmer to use new methods is a normally slow business, and it is therefore encouraging that after so short a time the Nigeria Cocoa Board is able to claim a startling success. A campaign to encourage better methods of cocoa preparation and fermentation, backed by the payment of large premiums for best quality cocoa, resulted in the proportion of Grade One cocoa increasing in two years from 20 to 80% of the crop.

Sierra Leone has introduced a cocoa grading system for the first time, and has decided to carry out measures to assist in the extraction and preparation of palm oil mechanically. The Nigeria Oil Palm Produce Board is considering the introduction of a new grade of palm oil to encourage the production of an edible oil; and the Gambia is taking steps to see that groundnuts retained for seed are properly stored and distributed.

On wider lines the Nigeria and Gold Coast Cocoa Boards have given most generous financial assistance to the university colleges which have recently been founded in these two territories. In addition, during the days of the West African Produce Control Board, the Gold Coast decided one year to accept for their cocoa a lower price than they had been demanding, on the understanding that the difference was put at the disposal of the Legislative Council. The latter resolved to devote the sum, which was over £800,000, to assist in the formation of a university college for the territory.

In short, the Boards hope to create efficient and prosperous industries, based on contented farmers assured of reasonably stable prices, and on efficient merchants and middlemen, fairly remunerated, to act as the Boards' agents.

Effects of Marketing Boards outside Africa

British West Africa produces slightly more than 50% of the world's cocoa; therefore, the establishment of the Marketing Boards was an event of some importance in the cocoa world; but to suggest that this enabled West Africa to dictate the price of cocoa is entirely wrong. Cocoa is a world-wide market, and Board or no Board, the laws of supply and demand still prevail. Incidentally, the U.S.A. is the largest consumer and therefore the Boards are important dollar-earners.

While cocoa is very much a market on its own, the groundnut, palm kernel and palm oil markets are bound up with those of copra, whale oil, soya beans, cottonseed, lard, tallow, butter and others, all of which are to a greater or lesser extent interchangeable. The establishment of the Oilseed Boards was not therefore of major significance in the oilseed world. Their three-year contract with the Ministry of Food, however, has some significance. Similar contracts have been negotiated with other British colonies and, in addition, the other metropolitan countries have various types of arrangement by which they too have first call on the oilseeds produced in their dependencies. This, combined with the currency difficulties which seriously limit Europe's purchases of U.S. and Philippine oils and fats, means that the free market in oils and oilseeds is severely restricted.

With regard to any effect that these schemes may have beyond their own markets, it is worth while remembering that from time to time economists have suggested that the slumps of pre-war years were accentuated, if not actually caused, by heavy falls in the prices of primary produce, with a consequent drop in the purchasing power of the farmers. Is it too much to hope, therefore, that the Marketing Boards, with their policy of price stabilisation, will in a small way assist in creating more stable economic conditions in the world?

British Aid for Jordanian Irrigation

The kingdom of the Jordan has laid plans for far-reaching developments with the intention of developing to the utmost extent the land within its boundaries. A start with the work envisaged is all the more pressing because of the vast number of Arabs, both Moslem and Christian, who have been forced by events to leave their homes and seek refuge in the kingdom of the Jordan.

The Jordan valley is the principal area where these people can be settled, and it is only by irrigation that the potentially rich land bordering the River Jordan can be made suitable for settlement on a large scale. The kingdom of the Jordan extends along the River Jordan for a considerable distance and also borders on the River Yarmuk where this important tributary joins with the Jordan, and thus considers itself entitled to a substantial share of the waters of both these rivers. Some years ago a survey was made of the potentialities of the Jordan valley area, and active studies of the engineering and agricultural possibilities have been continued in spite of the difficulties experienced during the war.

A well-known firm of British irrigation engineers have recently been employed to make the best use of the water available. They are now employed on drafting practical schemes of irrigation for the Jordan valley in so far as it lies within the kingdom of the Jordan.

In view of the urgency of providing a living for the dispossessed, as well as for the normal development of the country, it is hoped that a start can be made at an early date.

Agriculture in Cyprus

Cypriot vineyards recently reclaimed from a once barren hillside

EVERY colony has agricultural problems peculiar to itself; those of Cyprus arise on account of the limitations imposed by an annual rainfall of about 14 in. and a very hot, dry summer, during which the shade temperature may reach 110°F. A recently published report on Cyprus agriculture in the decade 1938-48* gives an interesting review of policies formulated to improve the agriculture in the colony and shows that a very material measure of success has been achieved.

Despite the climatic difficulties, Cyprus produces an astonishingly wide range of agricultural products. The cultivated area is 1,000,000 acres, operated by 60,000 people. The crops include grapes, carobs, wheat, barley and oats, potatoes and other market-garden crops, cotton, tobacco, olives and citrus. In the hills many deciduous fruits are grown, while sericulture and animal husbandry also have their places in Cyprus agriculture. Great importance is attached to the training of the Cypriot staff for appointment in the Department and for promotion therein, and one feels that the successes of the Department have been materially assisted by the intelligent co-operation of the locally recruited staff.

Attention has been directed to soil conservation and irrigation and some 133,000 acres are now under irrigation. A Soil Conservation Service has been set up which has undertaken the terracing of steep hill slopes, contour banking of more gently sloping land, levelling of fields and the construction of earth training banks to facilitate flood irrigation from rivers.

Investigations on soil fertility have shown that cereal crops can be maintained without the customary fallowing in alternate years by the cultivation of grazing crops. Organic matter is not readily produced and is easily decomposed between seasons. Completely unmanured soils have a humus content of about 0.3%, and it is considered uneconomic or impossible to raise this figure above 2%. It is concluded that under climatic conditions in Cyprus, purely from the point of view of crop yield, a high humus content is of no particular value.

A valuable vegetable and flower seed industry has been established and exports of seed have increased rapidly. The secret of success has been the extreme care taken in supervising the cultivation and roguing of the crop, and in the cleaning, packing and shipping of the seed which has been undertaken by the Department.

Considerable advances have been made by private and co-operative enterprises in the production of wines. A Colonial Development and Welfare grant has been used to assist in the replanting of vineyards with superior varieties of grapes.

Olives and olive oil are very important items in the diet of the Cypriots, but only in the most exceptional years is the colony self-supporting in these commodities. An expansion of the industry is stated to be one of the principal objects of agricultural policy. Forest olive nurseries have been established comprising vigorously-growing wild olive trees. These are budded *in situ* and later sold to planters. Olive nurseries have also been established by the Department and more are to be started.

Cyprus is mainly dependent on sheep and goats for its requirements of meat and dairy products. Dairy cows have to be fed on fodder especially grown for them; consequently they are expensive to keep and are found only near large centres of population. To control grazing, efforts are made to eliminate free-range goats in favour of tethered goats. The latter give more milk and do not contribute to the erosion problem. The improvement of milk production of goats by suitable feeding and the importation of improved stock has been undertaken.

In poultry, the ' Cyprus Black,' a bird of the Minorca type, has been developed as a good layer. Poultry extension work has been considered necessary by the general neglect of proper housing and maintenance of poultry in the villages.

The publication compresses into 56 pages the progress of ten years' work. Necessarily, therefore, the present review can but indicate some of the highlights of the report. The publication is deserving of closer study by reason of the interest attaching to the work done and by the clarity of its presentation.

D. H. GRIST

**Investigations and Developments in Cyprus Agriculture*, 1938-48. By J. McDonald, C.B.E., B.Sc. (Hons.), F.L.S., Director of Agriculture. Cyprus Government Printing Office, Nicosia, 1949. 56 pages, 5s.

New Rye Variety

Scientists at the Plant Breeding Institute in Wageningen, Holland, have developed a new variety of rye which promises a higher yield than existing strains. The seeds of the new rye, which is known as Tetraploid Petkuesser, are nearly twice as heavy as those of normal rye and the straw is reedy.

The variety has already been sown experimentally in various parts of Holland. First results are understood to be satisfactory.

Progress in Fruit-Spraying Methods

M. H. MOORE, M.Sc.

East Malling Research Station

The technique of spraying and dusting fruits to protect them from pests and diseases has been revolutionised during the last decade by the advent of new compounds and new application methods.

The following survey of methods of fruit spraying used today is reproduced, by permission, from the Annual Report of the East Malling Research Station.

SPRAYING began very tentatively; Lodeman (1916) in his book, *The Spraying of Plants*, stated that up to late in the 19th century 'syringing' was the word commonly used—it consisted in 'throwing upon the plants any fluids or semi-fluids in the form of a fine rain or mist.' This was usually done by using crude syringes or by swishing droplets from brooms or besoms dipped into a pail of the fluid. In a later development the besom had a hollow handle, which was attached to a small tank carried on the back. The liquid flowed along the fibres of the besom and was shaken off the ends. One interesting feature was the selection of mostly evil-smelling fluids in the hope that these would have a more deadly effect on the pests. Thus in 1763 there was a Marseilles remedy for plant lice—a mixture of milk of lime and bad tobacco finely powdered, applied by means of a small tin syringe having a nose pierced by about 1,000 holes. From this it was an obvious step to improved watering cans; gravity feed gave way to a simple bellows pump, and non-return valves were introduced.

Undoubtedly the chance discovery of the fungicidal effectiveness of Bordeaux mixture in 1882 gave a fillip to spraying. Here was a mixture that could save the French vineyards from the destructive downy mildew disease if some satisfactory means could be found of putting the fluid on to the vines. Not long afterwards the prototypes of knapsack machines as we know them were in use. Then hand-pumped machines on wheels were developed; pumps were geared to the wheels; and ultimately an engine was provided to drive the pump. The aim was to apply as uniform coverage as possible in droplet form, and sprays that we should now regard as unusually strong ones were the general rule.

The researches of pioneer entomologists and mycologists were constantly revealing new facts about the organisms to be controlled, and these workers urged upon growers the need for more spraying. The growers in their turn asked the manufacturers for better machinery, and so the industry arose.

Spray machinery

Spray nozzles were an interesting development, for it was appreciated that the type of spray mist could be largely determined by the nozzle assembly; in fact, that the efficiency of spraying was not entirely dependent on the kind of pump used. First a solid jet was used; then it was found more satisfactory to break this up, which was done by having a rough edge to the hole or orifice, or by obstructing the jet in some rather crude manner comparable to the gardener's thumb over the end of a hose when sprinkling. Later, nozzles were constructed so that a swirling motion was imparted to the flow of liquid before it emerged from the orifice.

After rapid initial progress, spray machinery developed steadily, showing improvements here and there without any revolutionary changes. Up to the early 1930s, practically all large-scale spraying was done either from a central pumping station linked to a network of underground mains, or from a portable machine worked from strategic points on the headlands, and coupled to overground steel or rubber mains. The central pumping station involved heavy capital outlay but, once installed, was simple and relatively cheap to maintain. Rubber hoses were coupled to stand pipes (from the underground mains) sited in convenient places throughout the plantations, and spraying was practically continuous, for the spray mixing and the care of the machine were in the charge of one man, whose job it was to keep up a steady supply of spray for the sprayers. With the portable machine the initial capital outlay was lower, but wear and tear was naturally a much heavier item, especially that on the steel mains system, for the flexible couplings between the lengths of steel pipe had frequently to be broken up so that the pipes could be moved to another part of the plantation.

[*Photo: courtesy East Malling Research Station*

Hand-pumped barrow outfit with long lance and single nozzle

Progress in the U.S.A.

Meantime, rapid progress was being made in the U.S.A. with the ' mobile ' system, in which the machine, self-propelled or drawn by tractor, moved through the plantation accompanied by the sprayers; in most cases they were accommodated on a specially constructed platform, and sprayed the trees on each side as they passed. This system was facilitated by wide alleys between the tree-rows, but it called for a large output from pumps and nozzles. Multiple nozzles were favoured, *i.e.* the spray ' broom,' in which a row of fixed-output nozzles is mounted in a nozzle head set at right angles to the lance. The advantage of this was that by employing a vertical motion of the lance, with the nozzle head horizontal, the trees could be ' brushed ' in passing with a spray that had width as well as carry. Hitherto, with a single adjustable nozzle, the jet could have one or the other but not both.

Developments in Britain

The influence of this development crept slowly into British methods, but once the idea was accepted it went ahead rapidly. The chief difficulty in this country was that in many plantations, especially those in the concentrated fruit area in the south-east, the alleys between the tree-rows were too narrow to accommodate a large travelling outfit of this type; moreover, the available machines and their accessory equipment could not deal with the large output of spray at high pressure necessary if the system were to justify any real claim to the term ' mobile.' It was useless to urge greater speed in spraying operations when the man at the lance was confined by the limitations of the equipment to much less output than — as demonstrations showed—he could easily and economically handle. Fruit-growers and the manufacturers of spray machines were alike subjected to a persistent campaign in favour of ' the new idea '; it was ably sponsored by Dr. T. Swarbrick of Long Ashton Research Station and Mr. J. Turnbull of the Ministry of Agriculture, and supported by other research and advisory officers keen to apply the urgent implications of biological research findings to the fruit-growing industry. ' Getting round ' a large farm in a maximum of four to five days with a spray for scab control was beginning to be a practical possibility and not, as hitherto, one of the more exasperating recommendations from the lecture platform.

Pump capacity

The radical changes consequently brought about in the design and pump capacity of mobile spray machines in this country made possible a great increase in the output of spray fluid. The replacement of long, single-nozzled lances by short, multiple-nozzled ones reduced the efforts and therefore the fatigue of the sprayers and gave each much more wash to handle, so that fewer were needed to share the increased total output. The introduction of quick-acting trigger valves on the lances avoided much waste of wash. Perhaps the chief popular fallacy exposed by the sharp contrast in methods was that spraying could be speeded up by increasing the number of sprayers operating from a single and inadequate machine of the earlier type. Its output was determined by the pump capacity, and every addition to the number of sprayers involved a smaller share for each once the pump capacity had been equalled by the output; the inevitable result was slower, not faster, work. The sprayers, at first perhaps a little suspicious of developments, greatly welcomed the new method on increased acquaintance and, by and large, soon forgot the old, though the transition period was inevitably accompanied by many clear instances of over-spraying.

Mobile versus central pumps

Relatively few growers in Britain were able to use a fully mobile outfit, *i.e.* with the sprayers riding on the machine, but many adopted the compromise of a mobile outfit with trailing hoses and the sprayers walking behind, which was found to be workable even in overhung alleys, where the trees were sometimes cut up a little to accommodate the system, and some plantations were thinned by judicious grubbing. It was in any case a great improvement on the use of overground mains from a headland machine, but it will perhaps remain a matter for fierce controversy by the advocates of a well-equipped central pumping station with underground mains, who—let it be said—have much to commend their point of view.

A rapid survey such as this may create an impression that progress along these lines was obvious and easy and might have been even more rapid than it was. It must not, however, be overlooked that there were problems to solve on the way. To appreciate one of the chief of these, it is necessary to recall the period before the ' revolution,' when it was customary to apply fungicides as soft, misty sprays of fairly high concentration, and contact insecticides such as nicotine and soap in as drenching a spray as the existing equipment would allow. As far as fungicides were concerned, we were still living in the shades of the early Bordeaux mixture era. Could fungicides such as Bordeaux and lime-sulphur ever be safely applied in the large volumes and at the high pressures demanded by the advocates of speed? Perhaps they could be if we put more water with them and added a spreader to make up in better distribution of the weakened spray what it had lost in strength. New spreaders were coming on the market to replace soap which, though safe enough with nicotine, would cause trouble if mixed with Bordeaux mixture, lime-sulphur or lead arsenate.

High volume-pressure spraying

As a result of many different experiments a very interesting conclusion was arrived at: it was that the inclusion of spreaders did not compensate for what the more dilute fungicides had lost in strength be-

[*Photo: courtesy Plant Protection, Ltd., and Kent Engineering Foundry, Ltd.*

Modern ' Automatic ' mobile sprayer

cause such compensation was already provided by the better cover obtained from using large volumes of spray at high pressure. In other words, the use of plenty of spray fluid, reduced in strength though it was, rendered the addition of spreaders to protective fungicides a luxury, though where such pests as capsid and aphids were to be controlled by foliage sprays, the spreader was still a good safeguard as these insects must be thoroughly wetted to kill them. G. G. Taylor, working in New Zealand, also concluded that the volume of spray applied was an important factor in the control of scab and red spider; increased volume was best applied, not by

[*Photo: courtesy East Malling Research Station*

Small power outfit with overland mains

[*Photo: courtesy Plant Protection, Ltd., and Kent Engineering Foundry, Ltd.*

Powerful modern mobile sprayer with short lance and broom of nozzles

adding to the time taken to spray, but by increasing the pump output and pressure, coupled with appropriate nozzle design. The more forceful application of fungicides was shown by experiments made at East Malling to increase spray damage, but greater dilution of the spray fluid kept this to reasonable proportions. Meantime, the work of Messrs. Davies and Smyth-Homewood, at Wye, had shown that high pressure was one of the chief requirements for a fine spray, which had always been regarded as the exclusive property of a small orifice delivering spray at low pressure—the so-called 'fine, misty spray' so often specified by the pioneer plant pathologist.

Insecticides and fungicides of carefully regulated dilution could, then, be satisfactorily applied together in large volume at high pressure. The machinery ultimately available enabled this to be done quickly and opened the way for the more frequent applications of spray rendered necessary by the increasing demands of the spray programme. The poor control of scab often achieved in the past, even with strong sprays, was clearly a result of inability to time the sprays correctly and to put them on often enough and thoroughly enough with the available machinery; this was demonstrated by the occasional failure of spray programmes that were entirely successful in small-scale experiments to give satisfaction when used on a larger scale.

Automatic spraying

The arrival of conditions that rendered feasible a policy of more frequent spraying to some extent coincided with increasing scarcity of labour and a sharp rise in labour costs. It was naturally undesirable that this rise should be allowed to offset, as it might ultimately have done, the progress so recently and so hardly won, and it was perhaps inevitable that attention should be turned more seriously to 'automatic' spraying for fruit trees. It now seems curious that this method should have waited so long for a trial in the top-fruit plantation when it had for many years been established practice in the hop garden. True, it had been successfully used experimentally in raspberry and loganberry plantations, for which the method is eminently suitable, long before apple and pear growers recognised in it a possible means of increasing the speed of spraying while reducing labour costs, but one feels that it is still regarded with some suspicion for top fruit, especially for winter oil spraying, where the cover achieved must be first class for really good control. There are, however, signs that its teething period will be relatively short, for the main essentials of good spraying are by now firmly grasped, and the automatic method will be judged by its ability to fulfil those essential requirements. If early demonstrations failed to convince, it was through failure to implement the lesson most recently learned, *i.e.* that speed in spraying coupled with satisfactory coverage can be achieved only by the use of an adequate volume of spray delivered at high pressure to provide the necessary impetus to the droplets to carry them effectively among the branches and foliage. Thus it seems clear that the less powerful automatic models are unlikely ever to be satisfactory for medium to large trees, especially while winter washing is regarded as an indispensable part of the spray programme. Much depends, however, on the arrangement of the nozzles, and the tops of trees may be the better sprayed if some of the nozzles are carried on a vertical extension above the machine.

The device that has gained most recent support in this country is that of impelling a fog of fine particles of dilute spray fluid through the trees by the boosting effect of the air blast from a power-driven fan built into the spray machine—the so-called 'speed sprayer' of America. A device operating on a similar principle was introduced many years ago by A. H. Burgess of Wye College for reaching the topmost parts of hop bines. The recent develop-

ment leaves little to be desired as regards speed of operation, but it has clearly shown how far the pendulum has swung by emphasising what is now perhaps the chief problem inherent in the 'large-volume, high-speed' principle—that of water supply.

Dusts

This problem could very simply be solved by the use of dusts instead of sprays. The process is simplicity itself—why, then, do we saddle ourselves with complicated machinery at great expense, and with the problem of how to keep it supplied with water, the sole purpose of which is to act as a vehicle for a *relatively* insignificant amount of toxic material? Dusts have hitherto been shown to possess poor sticking and weathering properties and past attempts to improve these have resulted in insuperable problems of dispersion. Particles of dust that have an artificial physical ability to stick to foliage are able also to stick to one another and produce lumpiness in the mass. The French are experimenting with electrostatic dusting, in which the individual dust particles are charged in an electric circuit before being dispersed to facilitate their mutual repulsion and at the same time their adherence to foliage.

Tests at East Malling and elsewhere have shown that fungicidal dusts provide less satisfactory control of apple scab than do wet sprays unless they are applied more frequently, when they can be quite satisfactory, especially in dry seasons. But weak sprays also should be applied frequently for success and, after a long campaign, more frequent application is now possible! It has always been possible to apply dusts frequently and this would appear to be a sound reason for our having already scrapped our cumbersome spray machinery in favour of relatively light, simple, power-dusting machines, and dusting as often as we felt inclined. For scab control alone this might prove effective, but hitherto it has been difficult to see how such a programme could conveniently accommodate the wet sprays necessary for the control of insects such as apple sawfly and codling moth. Rain provides sufficient weathering problems for the average dust without the added effect of drenching a freshly applied dust deposit with spray applied at high pressure. Moreover, it would have been undesirable to use lead arsenate, for example, in dust form on account of the drift, even if it were shown to be effective in that form against biting insects.

Photo: courtesy Plant Protection Ltd.

Power dusting machine

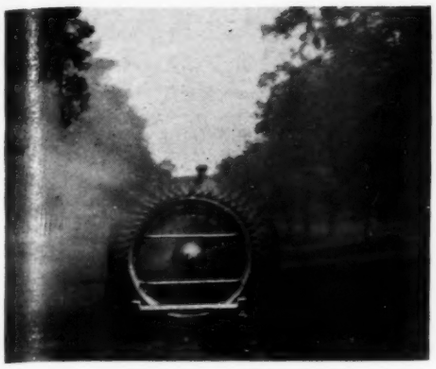
The collaborative research of chemists, entomologists and plant pathologists may in future indicate new possibilities for a dusting technique in the plantation where the whole control programme could revolve around it. Nevertheless, it is still a moot point whether the indiscriminate release of dust clouds could ever be seriously considered feasible on a large scale unless chemicals harmless to mammals while effective against pest and disease organisms can be found; at present, mammalian toxicity is of increasing concern as regards certain of the newer insecticides and fungicides.

Atomising fluids

Another possible solution of the water problem lies in the use of atomised fluid concentrates (a swing of the pendulum back towards the origins of spraying), where air and not water is the diluent and vehicle, as with dry dusts. An English firm claims to have introduced this idea into agriculture some 70 years ago, but it has never made much headway in the open air. Research on poison 'gas' clouds and screening smokes for war-time use has provided a new impetus for the agricultural application of the principles involved, and spraying from aircraft of otherwise inaccessible insect-ridden areas has become a matter of common acceptance. The spraying of ground crops from the air is also receiving attention and the practicability of this method for fruit plantations is an interesting speculation. Progress has recently been made, especially in the U.S.A., in the development of machinery for blowing clouds of atomised concentrates among fruit trees from powerful machines operated on the ground; these are fitted with either a large fan assembly to generate an air blast, or with a mechanism for releasing compressed air that has been raised to a high temperature. The prin-

[Photo: courtesy Plant Protection Ltd.

The overhead mains system



Modern automatic mobile sprayer using boosting effect of air-blast

ciple is the same as that of the 'speed sprayer,' with the added advantage that the dispersal of concentrates does solve the water problem, though it clearly raises others, particularly that of drifting, uncontrollable clouds of highly toxic materials, as with the dry dusts. Moreover, a balance must be maintained between the degree of coverage of the host required to give control and excessive coverage, which may cause severe spray damage. This problem is likely to be solved only by restricting the size of the individual droplets of the fog and the period of exposure to it within certain limits yet to be determined; the coalescing of droplets to form slowly drying pools on the leaves, as with dilute sprays normally applied, would appear to be highly undesirable with at least certain forms of concentrate.

The spray duster

The combined use of dusts and atomised liquids is practised in the U.S.A. by means of the sprayer-duster, which disperses liquid and dust mixed together in the same air stream just before discharge. Initial sticking properties are thus imparted to the wetted dust particles.

Research on the potentialities of these methods alternative to conventional hydraulic spraying for fruit trees has so far made little headway in this country because of the lack of suitable machinery for plantation use; suitable chemicals for atomising also are required. Small-scale experiments at East Malling have so far shown that apple trees, even Cox's, can safely be treated with atomised lime-sulphur concentrate when very carefully applied, and that the scab control achieved is as good as that from the routine method. The difficulty in small-scale work in the open is to achieve uniform coverage of the host by the aid of an air stream of only relatively low velocity; even a light breeze proves troublesome under these conditions. Moreover, large-scale experiments sometimes reveal problems that were not encountered on a small scale.

Clearly, much more experimental work, followed by practical experience, is needed before a sound judgment can be made as between the conventional and the new. It seems unlikely at present that hydraulic spraying will be displaced as a standard method of applying insecticides and fungicides in the fruit plantations of this country for some time to come—at any rate, until there is far more evidence than we have at present that the new is worthy to replace the old. Ultimately it may be possible to dispose altogether with the principle of smothering active young green leaves, as well as the fruit crop, with noxious chemicals in favour of a more subtle method of pest and disease control.

Agricultural Projects in Middle East

FOUR 'demonstration projects' to show Middle Eastern countries how to turn their deserts into green fields and raise the people's standard of living are recommended in the final report of a United Nations' economic survey mission headed by Mr. Gordon Clapp. These would demonstrate 'technical teamwork' and give the governments of the countries concerned — Jordan, Arab Palestine, Lebanon and Syria—experience in planning and execution, the report says.

The four schemes could lay the basis for more important and large development schemes, though 'the obstacles to economic development (in the Middle East) leave few opportunities, if any, for the immediate prosecution of large-scale schemes or the fruitful application of long-term credits for productive, self-liquidating developments.'

Main outlines of the four schemes are as follows:

(1) **Jordan:** THE WADI ZERQA PROJECT. It is proposed that this watershed area be developed completely and as a unit. Roads would be constructed to make the area easily accessible; a dam of rock and earth would be built across the wadi to control the floods in the rainy season and to save some of the surplus water for release in the summer, thereby doubling the land to be irrigated.

(2) **Arab Palestine:** THE WADI QILT PROJECT. Construction of a dam will permit efficient use of the water and this in turn will increase the usefulness of land now idle. This development, like the Wadi Zerqa development, can start as a works project, employ refugees and give them an opportunity to settle in the state-owned lands their work enriches.

(3) **Lebanon:** THE LITANI RIVER INVESTIGATION PROJECT. The engineering experts of the mission estimate that a series of storage dams could develop as much as 200,000 kW of power, capable of producing 750,000,000 kWh of electricity each year. In addition, these storage dams would increase the water supply for irrigation far above even the maximum needs of the irrigable land along the coast from Tyre to Sidon. It is proposed that the task of making a complete study and technical investigation of this river and its watershed be undertaken as a pilot demonstration project.

(4) **Syria:** THE GHAB VALLEY PROJECT. This pilot demonstration project would consist of a complete engineering, agricultural and economic plan for the development of the valley as a whole. The problems of drainage, highways, housing, malaria control, public health, village organisation, flood control, irrigation, hydroelectric power and agriculture would combine in a single project a veritable small-scale model of the problem of Syria as a whole.

The report said these projects were chosen by the mission because they were high on the list of projects which the governments of the countries concerned would like to undertake and, furthermore, because they were of a size and cost which was either limited by the very nature of the project itself or which could be limited 'without doing violence to possible future expansion of the project.' The report continued: 'These projects are capable of completion within a few years and will exemplify in a practical manner the steps required to turn ideas into action. On the other hand, they are varied in their nature and require in handling some interesting differences in technique.'

The report stated that there was not much prospect of substantial foreign credits on a business basis, public or private.

The governments of each of the countries studied by the mission suggested many useful economic projects, but the prospective contribution of such small ventures as might prove attractive to foreign investors was small in relation to the basic development requirements of the area.

Rye for Drift Control and Grazing in Australia

H. J. SIMS, M.Agr.Sc., B.Com.

Cerealist, Department of Agriculture, Victoria

IN 1945-46 the Australian acreage under rye was nearly 63,000. South Australia, with 52,000 acres, had the largest area. The acreages sown in the other states were approximately as follows: Victoria, 8,000; Western Australia, 2,000; and New South Wales, 500.

In Victorian agriculture, rye occupies only a minor place. Prior to 1940 it was sown mainly for green fodder purposes. Up to that time, the area sown was in the vicinity of 1,000 acres, but since then the area has increased rapidly and in 1948-49, 16,606 acres were sown. This increase was due to the increased acreages sown in the Mallee, principally for soil-drift control purposes. Acreages sown to rye each year in Victoria for the period 1930 to 1947 are shown in the accompanying graph.

Rye has proved a suitable crop for early green feed, for which purpose the Victorian crop was mainly used prior to 1940. The bulk of the area was sown in districts having cold winters.

Rye is not a satisfactory cereal for cutting for hay. The straw is very coarse and there is a strong awn or beard on the head. Under Victorian conditions the grain yield is not satisfactory. The rye plant is not self-pollinated as wheat is and, under dry conditions, wind-blown pollen may be dessicated before reaching the stigma of another plant. Under these conditions the number of grains set in each ear is low, and this, together with the small size of the grain, results in low yields.

It does not seem probable that rye will be cultivated in Australia for its grain. In addition to its low yield, the prices that the grain could be expected to realise would not make its cultivation as profitable as that of the other cereals. As a feed grain it has a flavour that makes it relatively unpalatable to live-stock when fed on its own; it must, therefore, be fed mixed with other grains.

In the pattern of Victorian agriculture, rye is a special crop which, unless something unforeseen develops, will probably continue to be produced in relatively small quantities—chiefly for the control of soil erosion and for early green feed.

In February we published an article on rye, by Dr. H. Hunter, as part of the series 'World Cereals Today.' In Australia of recent years this crop has become more and more widely used to control soil drift and wind erosion.
The following account of its employment for these purposes, reproduced from the 'Journal of Agriculture of Victoria,' supplements the information given in the previous article.

Rye for drift control

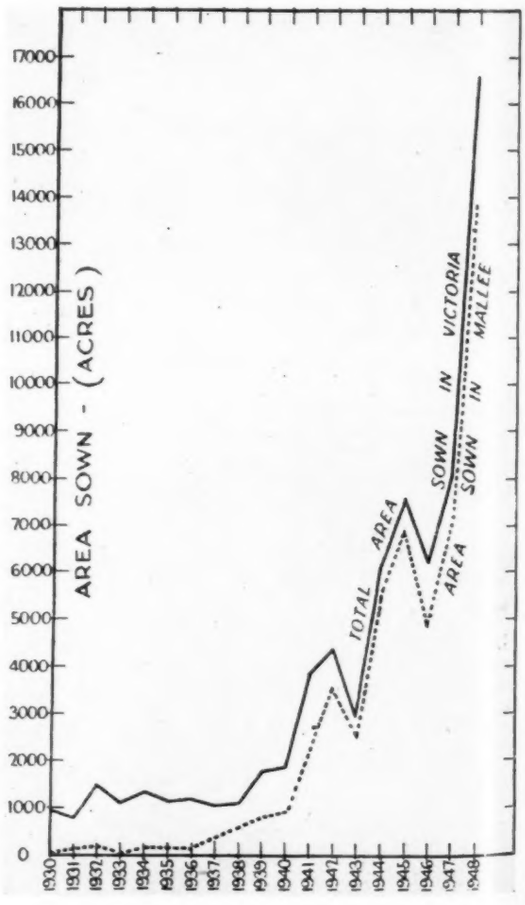
The blowing of sand-hills which have been denuded of vegetative cover by over-grazing or other means is a very serious form of erosion in the northern Mallee.

The value of rye in retarding drift has been responsible for the rapid increase in acreage sown over the past few years. Of all cereals grown in Mallee areas, rye withstands the onslaught of sandblast best.

After a period of testing on the Mallee Research Station at Walpeup, supplies of rye seed were built up. These were distributed to Mallee farmers, most of whom reported favourably on the crop. In 1943 the Department of Agriculture initiated demonstration areas to show the value of rye in stabilising sand dunes and reclaiming wind-eroded areas. This work was later extended in collaboration with the Soil Conservation Board.

The preliminary work on each demonstration site before sowing consisted of ploughing up exposed hard patches or limestone areas where necessary, levelling of the hilltops in so far as was practicable and the removal of stumps exposed by loss of topsoil. The whole area was then sown to rye. A standard seeding rate of 45 lb. of rye per acre was adopted, while a dressing of 50 lb. of superphosphate was used on the bulk of the area. In all cases, the response to superphosphate was obvious.

The demonstrations showed that the formation of sharp ridges can be halted by the establishment of cover on the sides of the ridges. The top will then blow and accumulate in the cover on the sides, reducing the height, and making it possible for the tops to be sown in a subsequent season.



The graph shows the big increase in the area of rye sown in Victoria in recent years. Most of this increased acreage is in the Mallee

In the year following sowing, the bulk of the growth usually consists of self-sown rye. Wild turnip and ham-and-eggs daisy usually become the dominant species in later years. After a period of years, when the amount of useful vegetation is small or if the cover thins out, the area should be sown again to rye or fallowed, using special precautions to prevent drift, and then sown to wheat.

Owing to its value in stabilising areas affected by wind erosion, the Soil Conservation Board has supplied rye and superphosphate free to farmers to stabilise drifting sand dunes. The Board has required from the land holders an undertaking not to permit stock to graze on the areas during the first season, nor to cut or burn the stubble. In each of the last four seasons, seed and superphosphate for the sowing of 3,000 to 4,000 acres have been distributed.

By sowing rye on light land adjacent to stock and domestic supply channels, the State Rivers and Water Supply Commission has successfully and profitably reduced the amount of sand which formerly drifted into these channels.

Rye can be used as a cover crop to prevent drift on fallowed land but, except possibly on very sandy rises, it is not as good as oats for this purpose. An objection to rye as a cover crop is that it is difficult to control the grazing to prevent seeding. Tests at the Mallee Research Station indicate that a cover crop of rye depresses the yield of the subsequent wheat crop sown on the fallow to a greater extent than a cover crop of oats will do.

Rate of seeding and manuring

When sowing rye to stabilise an area, it is important that the ground be covered with vegetation as quickly as possible, and that a large bulk of straw be obtained to give protection for several years.

Tests have been carried out to determine the best rates of seeding and manuring of rye to achieve an efficient ground cover and the maximum growth of straw. These trials, over the period 1944-47, showed that a seeding rate of 45 lb. per acre and 50 to 60 lb. of superphosphate per acre can be recommended for erosion control.

Time of sowing

Sowing should be carried out under conditions that will enable the plant to get a good start and reach a 'safe' stage as quickly as possible. Therefore, the sowing should be done as early as possible after the autumn break of the season. Growth is more rapid when the soil is warm and, under such conditions, a cover sufficient to give protection against wind-blasting is obtained more quickly than later in the season. If sowing is delayed until May or June, soil conditions are colder, emergence and the obtaining of a good ground cover are slower, and the risks of failure are much greater than with early sowing.

Whenever possible, wet sowing should be practised, as seed sown in dry ground may be exposed or blown away before rain falls. To assist in giving protection to young seedlings, the surface soil should be left as well ridged as possible when the rye is sown. Such ridging, which can only be obtained when the soil is moist, may be sufficient to protect young plants during the first windstorm after sowing.

Rye for grazing

As stated earlier, most of the rye grown in Victoria prior to 1940 was sown for early green feed.

In the grazing trials, two strains of rye were tested along with other cereals. Both strains gave more early green feed than oats, barley or wheat. With green fodder, palatability of the crop is important. In some years, at the early grazings, the sheep grazed all varieties of oats and rye evenly, but on other occasions the rye plots were eaten bare before the oats were eaten, indicating that rye in its early stages of growth is very palatable. At the late grazings rye, which commences upright growth early and quickly becomes coarse and stemmy, was definitely unpalatable.

With regard to nutritive value, chemical analyses carried out by the chief chemist of the Department showed that rye, at the early grazings, compared favourably with other cereals with respect to total protein, but the percentage of carbohydrate plus fat was lower than oats or barley.

Rye for fodder should be regarded purely as a green-feed grazing proposition. Although it recovers well after early grazing, neither the hay nor the grain produced is as attractive as that obtained from oats.

When rye is sown to stabilise sandhills, it should not be grazed. Rather it should be allowed to produce the maximum growth of straw.

Varieties of rye

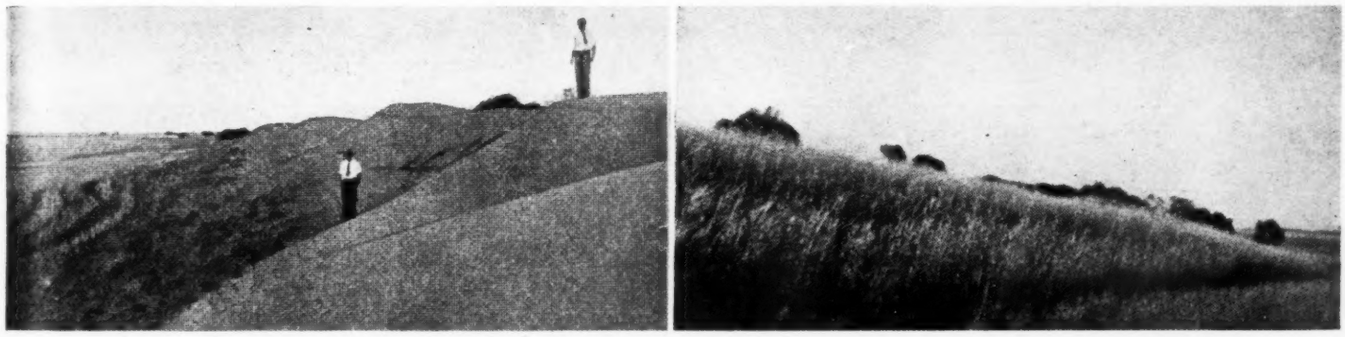
Unlike wheat, oats and barley, rye is normally a cross-pollinated plant, and different varieties sown together soon become mixed. Because of this and because of the fact that rye has occupied such a small place in Australian agriculture, little work concerning rye varieties has been undertaken in that country. Varieties tested at the Mallee Research Station include South Australian, Black Winter, Balboa, Slav and a number of varieties imported from overseas.

South Australian rye is an early-maturing type, with fast early growth. It appears that this variety has been produced by natural selection over a long period in the rye districts of South Australia and is thus well suited to Mallee conditions, particularly for sowing on sandy areas.

The variety Slav also makes fast early growth and is of similar maturity to South Australian rye.

Black Winter is of later maturity. It has a greater stooling capacity than South Australian or Slav and is the variety most commonly grown for green feed in southern Victoria.

Balboa rye was developed in Missouri as a fast-growing green-fodder type. Its growth type and maturity are similar to Black Winter.



The photo of the sand dune on the left was taken in 1941. *On the right is the same dune in* 1943, *stabilised with rye*

The varieties imported by the Department of Agriculture from Canada, northern United States of America and northern Europe, generally have proved too late and too slow in early growth for Mallee conditions.

The most important disease of rye is ergot (*Claviceps purpurea*), but it has not been noticed in the Mallee. Feeding stock with ergot-infected grain can cause serious losses because of its poisonous properties. Ergot has certain medicinal uses and, because of the difficulty of importing it during the war, rye was grown in some southern districts to provide a 'crop' of ergot.

Feeding rye hay and grain to stock

It has already been pointed out that rye hay and grain are inferior to hay and grain produced from other cereals. However, in drought years it may be possible to cut rye hay when other areas intended for hay are too short, and surplus rye grain after harvesting can be utilised for stock food.

The best quality rye hay is obtained when the crop is cut at the flowering stage, before the stems become too harsh and woody. Its food value in such a condition is roughly equal to wheaten hay which has been cut at the same stage of growth, and it can be fed safely on its own or mixed with other roughages. The feeding value of rye hay is lowered by the presence of the awns in the ear.

Rye straw is seldom used as a foodstuff, but it is particularly useful for thatching. It is also suitable for bedding down livestock.

The food value of rye grain is roughly equal to that of wheat or barley, but when fed in large quantities, is less palatable. However, this disadvantage can be largely overcome by mixing the grain with better-liked concentrates so that it forms only part of the concentrate mixture. Sheep eat the grain more readily than horses, cattle or pigs, and the sheep can be fed with rye without the addition of other grains or concentrates.

Rye is suitable for feeding to pigs, but is not as good as wheat for this purpose. It gives more satisfactory results when fed in combination with wheat.

Except when fed to sheep, the grain should be ground to a fine but gritty texture. Rye used as stock feed should be free from ergot.

Summary

Rye is the most satisfactory cereal for stabilising loose sandhills in the Mallee. For this purpose, rye should be sown as soon after the middle of March as weather conditions permit. Seeding rates of approximately 45 to 50 lb. per acre and fertiliser rates of 50 to 60 lb. per acre of superphosphate give satisfactory results. Such a crop should not be grazed.

Rye may be used as a grazing crop. It provides more early feed and a greater total quantity of green feed than other cereals, but is not as suitable as oats where the crop is allowed to recover and produce a grain yield after being fed off in the early stages of growth.

A strain of rye which appears to have developed by natural selection in South Australia is recommended for Mallee sowings.

Rye grain as a stock food is best utilised in combination with other grains such as wheat. When so used it is a satisfactory food.

Devaluation and Jute

AT a special meeting of United States' jute interests recently the Consul-General for Pakistan in New York, Mr. L. Shaffi, spoke on his country's jute industry in relation to devaluation. He opened by reminding his audience that Pakistan had decided to maintain the value of the Pakistan rupee at existing levels, *vis-a-vis* the U.S. dollar. Pakistan had enjoyed a favourable balance of trade not only with hard currency areas, but with the world in general, contrary to the devaluing countries. The effects of retaining the existing currency levels had been to discourage inflationary tendencies likely to raise prices of exportable commodities. As was well known, the price of jute was governed largely by the cost of the bare necessities of life to the cultivator, and recent welcome trends had shown price levels of jute to have fallen approximately 25%.

Since devaluation, the Pakistan Government had established the minimum selling price for raw jute of Rs.23 per maund, which would be operative until June 30, 1950. A Jute Board had been set up to investigate current marketing procedures, with a view to seeking methods to cut costs in marketing, baling and export charges and also to improve efficiency in transport and port services.

Mr. Shaffi went on to mention that Pakistan produced more than 75% of the world's supply of raw jute and outlined the calculations for world consumption of the fibre on which his government's long-range jute policy had been based.

About 60% of the world's jute mills were located in India, consuming roughly 6,500,000 bales of raw jute annually. With another 500,000 bales consumed outside those mills a working computation for Pakistan (without her own mills) and India together would be approximately 7,000,000 bales. The average consumption for the rest of the world for 1934-39 was not less than 3,500,000 bales per year. Therefore the total world consumption of the fibre might be expected to continue at around 10,500,000 bales annually.

India had declared as far back as last June that she was determined to be independent of Pakistan as a source of raw jute. On the basis of that declaration the government of Pakistan had assumed that India's order of Pakistani jute would be insignificant.

In writing off India as a prospective customer, Pakistan earnestly believed she may well have been taking a step towards putting the jute industry back on a healthy competitive commercial basis. Mr. Shaffi then mentioned the possible consequences if India bought no jute from Pakistan. First, if India were to double her current raw jute harvests to 4,000,000 bales, her jute mills would still be producing far less goods than the world can actually use. Production at such an uneconomic level would so inflate prices of the finished product that jute manufacturers in other countries would be able to compete successfully with Indian jute manufacturers.

Secondly, in view of the pressing need for raw materials in her own mills, it was unlikely India would be able to spare any raw jute for export.

Thirdly, Pakistan would be able to satisfy all her jute customers abroad by offering adequate supplies of the fibre at equitable prices.

Pakistan was shortly erecting three new jute mills with a capacity of 1,000 looms each. While these were being built the government would pursue a programme to process raw jute on their own account in those countries where spare manufacturing capacity existed.

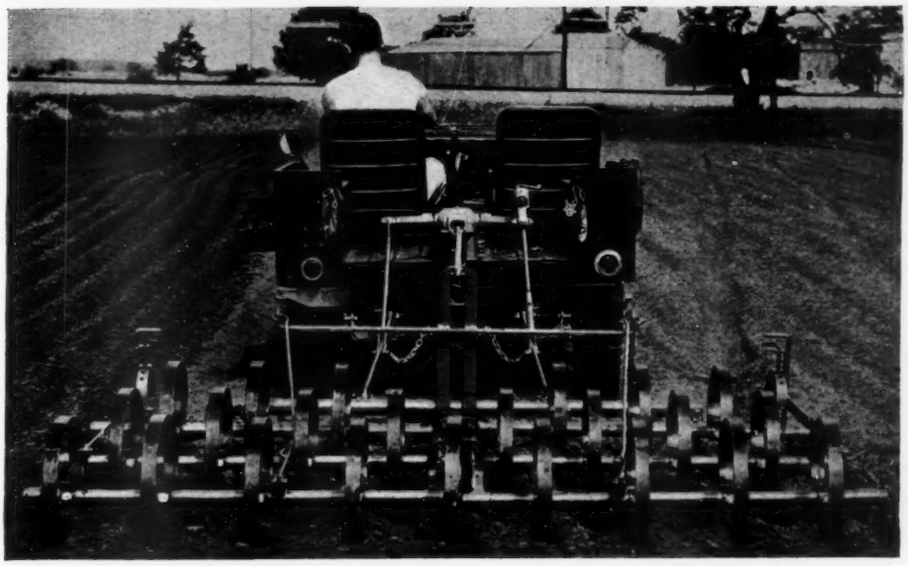
FAO's Rome HQ

At the final plenary session of the fifth annual FAO conference held in Washington it was decided to establish FAO's permanent headquarters in Rome. It is expected that the move will take place in the spring of 1951, when the next conference will be held.

FARM MACHINERY

The Versatile Jeep

Last month we published an article on the uses of general purpose vehicles for agriculture. The photographs on the right show the Jeep pulling a spring-tine cultivator, driving a circular saw from the power take off and hauling four gangs of discs through the soil. Note the mode of attachment of the cultivator in the top picture.



Mechanical Tea Harvester Tested in Ceylon

The Tarpen cropper, a machine for mechanically plucking tea leaves, won favourable comment in the Ceylon press as a result of preliminary experiments conducted in Ceylon several months ago, according to the American Embassy in Colombo.

The experiments tested the machine against the best hand pickers. Tea leaves harvested by the machine were manufactured separately from those plucked by hand. Three members of the Tea Research Institute of Ceylon compared results of the two methods of harvesting. They announced: 'We are satisfied from preliminary experiments that quality does not suffer. . . . The reaction on yield now has to be determined. . . . Without committing ourselves, we can state that machine-plucking yields to date indicate that the selectivity of the Tarpen cropper is of the same order as that achieved by good hand pickers.'

Because of the cheap and plentiful labour supply which normally exists in Ceylon and India, the advisability of mechanisation has been questioned. However, wages have more than doubled since 1946 and are still rising. The urgent necessity for increasing food production will draw many labourers away from the tea industry in the near future, and there is less concern that mechanisation will create unemployment.

New Steyr Tractor

Mass production of the Austrian Steyr works' new one-cylinder tractor should now be well under way. The tractor, known as Type 80, is equipped with a 13/15 h.p. diesel engine and has four gears; the first three permit speeds of from 3 to 7 km. per hour for field work and the fourth a speed of 15 km. for road transport purposes. Production is to be at the rate of 400 units monthly during the initial stage of operation.

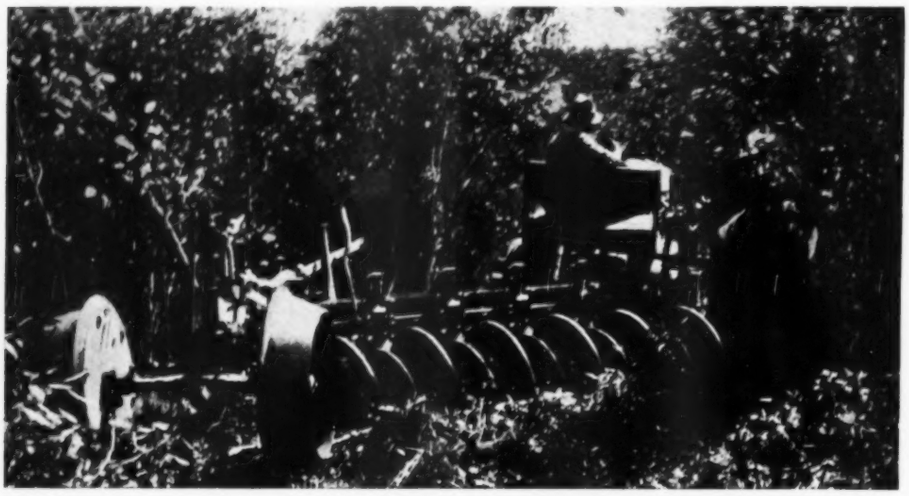
Production of the Steyr two-cylinder tractor will be maintained at the rate of about 500 a month.

Trailing, Rolling and Stump-Jump Disc Ploughs

Disc ploughs were designed in an endeavour to reduce friction by substituting the rolling action of a large concave steel disc for the sliding action of the share and breast of a mould-board plough. The disc is set at an angle to the line of travel of the implement and scoops a furrow slice to one side. The more vertical the disc the deeper it penetrates and the greater the angle between the disc and the line of travel of the plough, the wider the slice and the greater the resistance of the disc to rolling. The furrow slice is pulverised to some extent when carried over the concave surface of the disc, and better inversion together with greater pulverisation can be achieved by use of a scraper. Trailing-type disc ploughs are normally made with at least two discs; they leave a rough surface which is receptive to rainfall and reduces wind erosion.

A rolling disc does not, however, obtain any penetration by ' suction ' as is the case with a mould-board plough. Without the use of hydraulics, penetration must therefore be obtained by weight. The discs are mounted on a heavy framework, heavy ribbed wheels are fitted to counteract side-thrust and provision is often made for the addition of extra ballast when working on hard ground. The weight of the implement offsets to some extent the advantage of reduced friction but makes it very suitable for rough work.

The rolling motion of each disc and the heavy construction of the implement led to the development of stump-jump disc ploughs in which each disc is individually mounted and spring-loaded on the main frame. This type of plough will stand up to work which would ruin a conventional mould-board plough in a very short time. Disc ploughs are also very suitable for working-in rubbish and their use for this purpose has given rise to the introduction of eccentrically-mounted discs. In this case alternate discs are of larger diameter and are offset, thereby giving low ridges and channels in the surface with greater benefit to soil and water conservation.



This and the photograph above show eccentric disc stump-jump ploughs at work clearing thick scrub in Australia

The merits of the ' stump-jump ' disc plough for land-clearing work are well known, and were referred to in an article in our November issue, as are the uses of the ' eccentric ' disc plough for soil conservation practice. Our illustrations show eccentric disc stump-jump ploughs at work clearing thick scrub in Australia.

Encouragement for British Grass Driers

The Ministry of Agriculture has announced that the Minister has made an Order extending for a further period the special scheme of grants and loans for co-operative grass drying. This applies to the establishment of collective projects by Farmers' Co-operative Societies and similar organisations for the artificial drying of grass and forage crops, carried out as a service to farmers during the present period of development of this method of grass conservation. These facilities will now apply to projects *in operation before June* 1, 1951. As hitherto, grants will be $33\frac{1}{3}\%$ of the total approved capital cost, including driers, buildings, field and transport equipment. Loans can be made for an additional $33\frac{1}{3}\%$ of total approved cost, repayable in four annual instalments at 3% interest.

Since the scheme was introduced in February 1948, some 27 co-operative grass-drying centres have been set up with government financial assistance amounting approximately to £150,000 in grants and about the same amount in loans. Twelve of the centres were set up by the Milk Marketing Board. Despite the prolonged drought, about 16,000 tons of dried grass were produced at these centres in 1949 on behalf of nearly 2,000 farmers.

Some 30 new co-operative grass-drying projects are in preparation or under consideration for 1950. The Minister hopes to see more groups of farmers getting together for this purpose and that more of the well-established farmers' co-operative societies will consider starting a valuable service to their members by setting up drying plants to provide them with a quota of feeding stuff for winter use.

Societies or groups of farmers who contemplate applying for assistance under the scheme should consult the Grassland Development Branch of the Ministry of Agriculture, 1 St. Andrew's Place, London, N.W.1, before making final plans or committing themselves.

A New Systemic Insecticide

The organo-phosphorous compounds are the latest class of chemicals to prove of utility as insecticides. The most interesting of these is the recently introduced bis (bis dimethylamino phosphorous) anhydride, developed in Britain by Pest Control, Ltd. This insecticide has the unique property of being absorbed into the sap stream of plants thus rendering the whole plant toxic to insects which penetrate the plant tissue and suck the plant juices. It is thus termed a systemic insecticide. Furthermore, it is selective and does not harm beneficial insects such as predators. This outstanding compound, marketed as Pestox III, is described in the following notes extracted from a paper recently read by Dr. W. E. Ripper before the 61st Annual Meeting of American Entomologists at Tampa, Florida.

THE startling rapidity with which pest populations build up again after spraying with kill-all insecticides has demonstrated that if an attempt is made to destroy the individuals of two species uniformly and in proportion to their numbers, the average number of individuals of the species that is eaten increases and that of the individuals feeding upon the other diminishes.

Selective insecticides

In 1941, H. S. Smith called attention to the possibility of the artificial segregation of resistant strains of pests by cultural practices such as spraying operations. It occurred to us that both these undesirable phenomena could be prevented by the use of selective insecticides—that is, chemicals which kill the pests but do not kill their natural enemies, and thus allow the latter to control the pests, even after the insecticide has spent its action.

This contention was tested in 1944 on *Brevicoryne brassicae*, and found to be correct when nicotine gas was used as a selective insecticide. More recently we have found that certain systemic insecticides are selective when used against aphids and red spider.

Systemic insecticides

Systemic insecticides are defined as insecticides translocated in the plant and effective at some distance from the site of the lodgement of the insecticide. The first to be investigated were selenium salts. W. M. Hoskins, A. M. Boyce, J. F. Lamiman and Neivswander and Morris showed that this insecticide is translocated and renders the plant toxic to pests for a considerable period, but the toxicity hazards have caused this compound to be abandoned.

Schrader first synthesised octa methyl pyro phosphoramide, and his entomological colleague, Kukenthal, discovered its systemic effect. In repeating Kukenthal's experiments we found that the insecticide was not only systemic but also selective, since when a team at the Pest Control Research Station at Cambridge, led by Dr. R. M. Greenslade on the entomological side and Dr. G. S. Hartley on the chemical side, has investigated the insecticidal action of this compound, its effect on plants and mammals and new and more practical methods of its synthesis.

Translocation

The phenomenon of translocation is now well established by the work of Kukenthal, ourselves, Bennet, Davis and Kirby, Floyd Smith and Blauvelt. There is a good deal of evidence of translocation upwards after spraying, including the remarkable effect of rendering leaves toxic against aphids which were not present at the time of spraying, but there is, as yet, little published information on translocation downwards.

Insecticidal effect

Regarding the insecticidal effect, a good control of 14 aphids and two red spiders in England and Africa has been achieved. The compound was used commercially in England last year for the control of hop aphis *Phorodon pruni*, red spider *tetranychus telarius*, strawberry aphis *Pentatrichopous fragariae*, cabbage aphis *Brevicoryne brassica*, rose aphis *Macrisiphum rosae* and *Myzus persicae* on tobacco. In all cases, prolonged toxicity of two to five weeks after spraying has been recorded. Full and low volume spraying was compared and, in the case of *Myzus* on beet, the same quantity of octa methyl pyro phosphoramide in 4 gal. and 100 gal. per acre gave the same results.

Promising results were also obtained in the prevention of aphis-transmitted virus diseases in the case of beet yellow virus, which is transmitted by *Myzus persicae* and *Aphis fabae*, and in the case of strawberry virus, transmitted by *Pentatrichopous fragariae*.

Because of the absence of contact insecticidal effect neither predators such as *Coccinellid* and the larvae of *Syrphidae* nor parasites are killed. Neither are they harmed by feeding on aphids which have died from the poison. It is therefore not surprising that in field experiments in which octa methyl pyro phosphoramide was compared with parathion and paraoxon, the octa methyl pyro phosphoramide sprayed fields showed prolonged control after one spray application, while on parathion and paraoxon sprayed plots the infestation reoccurred quickly, leading in 10 to 14 days to a higher population density than before treatment.

Mammalian toxicity

Toxicological and pharmacological work has shown that the mammalian toxicity is similar to that of parathion, only slightly less. Analysis of sprayed plots has shown that no toxic residue can be detected at harvest if crops have been sprayed up to six weeks beforehand and, in feeding trials under the same circumstances, no toxic effect to mammals could be found. Although nearly 2,000 acres were sprayed this year no ill-effects to humans were observed. All workers were under continuous medical supervision and were protected from spray drift by protective cabs on the tractors.

All sprayed crops were analysed before harvesting commenced and in no case was any trace of octa methyl pyro phosphoramide found. A sensitive method for the determination of this chemical in plant material has been worked out.

At a press conference held in London early in January of this year Dr. Ripper amplified the above by pointing out that 'As we rely upon the plant to circulate the insecticide within itself, the chemical must be applied at a time when growth is active and the sap stream moving. If applied during winter when days are short and

(*concluded overleaf*)

Safflower Seed as a Cattle Food

The importance of oil seed crops is growing, and safflower seed is one with which readers may not be so familiar. As a protein concentrate it is a useful feed and it is also used as an organic manure when in undecorticated form. The following information came from various sources, particularly the Imperial Institute, London. Reports of two feeding tests, using the oil meal, are included.

SAFFLOWER seed is derived from *carthamus tinctorius*, a member of the family *compositae*. It is a native of Asia and is extensively grown in India. It is also grown in Egypt, Turkestan and to a limited extent in a number of European countries, including southern Russia and in the north-west of the U.S.A. The plant resembles the sunflower, but is stated to be more resistant to some of the pests and disease that attack that crop.

The seeds have a hard, shining, yellowish husk and are about 7 mm. in length and 4 mm. in breadth. They contain about 25% of oil, which closely resembles sunflower oil.

Analytical data

The analytical data in Table 1, taken from Bolton's book, *Oils, Fats and Fatty Foods*, gives its composition; the corresponding figures for sunflower oil are included for comparison.

The flowers yield a yellow dye which should not be confused with saffron, and the presscake is a valued cattle food.

In India, where the oilcake is produced in two forms, decorticated and undecorticated, the former is used as a cattle feed, whereas the latter is mainly used as manure.

Feeding value

Feeding experiments with safflower press cake and meal have been carried out in the United States and the following extract from Circular 366, U.S. Department of Agriculture, 1935, summarises the results:

'Several feeding experiments in the United States and Germany indicate that safflower seed press cake or meal may be used as a protein-rich concentrate much the same as cottonseed meal, linseed meal or soya bean meal in feeding livestock. When it is fed in such quantities as are necessary to supply protein adequately, it appears to have no undesirable effects upon the animals or the flavour of their products. The decorticated press cake has about the same protein content as cottonseed meal, and the press cake made from the whole seed has about the same protein content as coconut meal, as Table 2 indicates. The meal, made from the seeds from which the fat has been extracted by solvents, has about the same protein content as wheat bran.

The products made from the whole seed have a very much higher crude fibre content than any similar products from oil-bearing seeds which are commonly used. In fact, they rank lower than most straws in this respect. Therefore, products from the whole seed should be fed principally to cattle and sheep, as they can utilise such fibrous feeds better than other livestock. If a concentrated ration is desired, the whole seed cake or meal should not exceed one quarter to one third of the grain ration. In feeding experiments conducted separately by two German investigators, feeding about 4.5 lb. of the press cake per head daily to dairy cows reduced the butterfat content of the milk slightly.

Feeding tests

'A limited feeding test was made by the Bureau of Dairy Industry at Beltsville, Md., to determine whether safflower oil meal (ground press cake) could be used in a dairy ration without affecting the quality of the milk. A grain ration consisting of 33% safflower oil meal from the whole seed was readily consumed by dairy cows without noticeable effect on the flavour or odour of the milk produced, and it was stated that it should be entirely satisfactory as a feed for cows.

'In a more extensive test conducted by the Department of Dairy Husbandry, North Dakota Experiment Station, Fargo, North Dakota, using the oil meal from the whole seed, it was reported that it is a fairly good substitute for linseed meal for milk cows and does not appear to be either constipating or laxative.

'The seed and oil cake or meal are reported by some investigators to be excellent sheep and poultry feeds.'

TABLE 1. COMPOSITION OF SAFFLOWER SEED AND SUNFLOWER SEED OILS

	Safflower seed oil	*Sunflower seed oil*
Specific gravity	0.925—0.926	0.924—0.926
Refractive index by the butyro-refractometer	63—65	60—63.5
Saponification value	190—194	190—194
Iodine number	135—145	125—140
Free fatty acids %	0.5 upwards	0.5—5.0
Unsaponifiable matter %	0.5—1.2	0.3—0.9
Titre C.	16—17	18—19

TABLE 2. COMPOSITION OF SAFFLOWER PRESS CAKE AND MEAL

	Press cake		*Meal*
	Decorticated seed %	*Whole seed* %	*(by solvent). Whole seed* %
Moisture	8.97	4.10	7.91
Ash	8.18	2.90	3.02
Protein	38.06	19.20	16.62
Crude fibre	20.96	42.60	45.64
Nitrogen-free extract (starches and sugar)	17.06	25.40	24.96
Ether extract (fat)	6.77	5.80	1.85

A New Systemic Insecticide

(*concluded from previous page*)

assimilation in the plant is slow, there would be little movement of carbohydrates and correspondingly little spread of the insecticide throughout the plant. The principle of translocation is based on the fact that the plant takes up the chemical and carries it like a plant-produced assimilation product in its system. Under normal growing conditions, the systemic insecticide is taken up and permeates the whole of the plant, which is thus rendered toxic, at any point, to sucking insects.

'Thus we have for the first time a weapon for the prevention of plant viruses, because we can stop the insects which are responsible for their transmission.'

WORLD CROP REPORTS

World soya bean production smallest of post-war years

World soya bean production in 1949 was placed at 501.7 million bushels, according to the Office of Foreign Agricultural Relations. This year's output is 10% below the record harvest of 558.4 million (revised) in 1948. Smaller crops are reported for the United States, China and several of the minor producing countries.

Canada's 1949 soya bean crop of more than 2.6 million bushels is a record and exceeds that of a year ago by 43%. This is the sixth consecutive season that soya bean production has shown an increase. During the crop year ended July 31, 1949, imports of soya beans and oil in terms of beans amounted to 878,000 bushels.

The **United States** produced about 215 million bushels of soya beans in 1949. While this output is 2% smaller than the record harvest of 1948, this country is again the world's largest soya bean producer. The yield of 22.2 bushels per acre is the highest recorded for the United States. The 1949 support price is $2.11 a bushel for green and yellow beans grading No. 2 and containing not more than 14% moisture.

European soya bean production is declining. **Italy** is the only country reporting production in the current year. The 1949 crop is estimated at 130,000 bushels, compared with 107,000 in 1948.

China's soya bean crop, estimated at 179.2 million bushels, is 15% less than in 1948, despite an increase in acreage.

Manchuria's 1949 soya bean crop of 66 million bushels is less than half the pre-war output. Production has declined in recent years chiefly because of the difficulty of marketing the beans and the tendency to grow more grains.

Japanese soya bean production has not been reported for 1949 but is expected to equal the 1948 harvest of 8.8 million bushels. It is difficult to obtain accurate estimates of production in Japan as plantings are principally on small plots for direct consumption by the producer. Possibly not more than one tenth of the total output is available for oil extraction.

Prior to World War 2, Japan's supply of soya bean oil came chiefly from beans imported from Manchuria.

South Korean soya bean production continues to increase. The 1949 estimate is 6.9 million bushels, compared with 4.9 million last year and 4.7 million in 1947. The entire crop is consumed within the country either as food or in the manufacture of edible products. Apparently there has been little, if any, commercial production of soya bean oil in south Korea. The government programme for 1950, however, calls for the production of 250 to 300 short tons of oil from soya beans collected this autumn.

The **Indonesian** soya bean production of 9 million bushels is somewhat larger than in 1948 and only 8% below the pre-war average. Apparently the government is interested in expanding soya bean output. It was suggested at the recent agricultural conference in Buitenzorg that production be increased by 3 to 4 million bushels.

Brazil's soya bean production has increased steadily in the past few years. The 1949 estimate is 1 million bushels, compared with 730,000 last year and 480,000 bushels in 1947.

Soya bean exports are not separately classified in Brazil's official statistics, but reports indicate that shipments amounted to more than 400,000 bushels in 1948 and possibly have been much larger during the current year.

A citrus grove in South Africa. The South African Board is reported to be experimenting with the marketing of lemons and grapefruit in packages one quarter the size of the full 'pockets' of 30 lb.

Opportunity for Turkish tobacco

At a meeting of the Turkish Tobacco Co-operative Co. of Rhodesia Ltd. it was stressed by the chairman, Mrs. S. A. Field, that an unprecedented opportunity offered itself to Rhodesian Turkish tobacco growers to establish themselves firmly on the American market. In 1949, Turkish tobacco growers were once more on the way to a seller's market. They had improved the quality of their final product so that it could compete with any other in the world.

Burmese rice crop smaller . . .

Burma's 1949-50 rice crop has been estimated to be 204,100,000 bushels of rough rice (6,430 million lb. milled) or 23% less than the 264,700,000 bushels (8,338 million lb.) in the year before. This harvest is 58% of the pre-war (1935-36/39-40) average harvest of 350 million bushels (11,025 million lb.). The production decline is attributed to civil unrest in Burma.

Exportable supplies from this crop for shipment during 1950 are estimated between 1,700 and 1,900 million lb., a sharp decline below 1949 exports of around 2,600 million lb. Pre-war exports averaged 6,500 million lb. annually.

. . . while Siam's exports increase

Rainfall late in the 1949-50 season was ample to produce a good rice crop in Siam, despite a late beginning of the monsoon. The harvest therefore may approach the near-record crop of the previous year. The rice surplus harvested mainly in December and available for export in 1950 is estimated by the Siamese Government at 2,650 million lb., slightly more than the target for 1949 exports of 2,580 million lb.

Australia Expands Crop Areas

The following tables are reproduced from the *Quarterly Review of the Agricultural Economics of the Department of Commerce and Agriculture of Australia.* They show the changes that have come about in acreage and production during and since the war.

From Table 1 it may be seen that the acreage of cereals has steadily increased since before the war, with the exception of maize, and hay acreage has decreased. Potatoes have increased by about 20%, while the acreage of productive vineyards has increased slightly by under 10%. Sugar, tobacco and cotton are all down—considerably so in the cases of the latter two. Flax acreage is up on the pre-war average, although it has decreased since the peak war years.

The figures in Table 2 are related to those in Table 1. It may be noted that the preliminary figures for cane sugar production in 1948-49 show an increase of over 50% on the previous year and exceed the production of the years before the war.

Mexico's 1948-49 tobacco crop estimate revised

Mexico's production of leaf tobacco during the 1948-49 season was estimated at 53.5 million lb., or 10% below an earlier estimate of 59.4 million lb. This compares with 50.9 million lb. in 1947-48 and an annual average of 51.4 million lb. during the previous five years, 1942-43 to 1946-47.

Native light types of leaf accounted for 64% of total production in 1948-49, as compared with 55% in 1947-48. Production of these types totalled 34.4 million lb. in 1948-49 and 28 million lb. in 1947-48. In addition to native light types, Mexico in 1948-49 produced 15.8 million lb. of dark leaf, 2.5 million lb. of flue-cured and 838,000 lb. of Burley.

The country's 1949-50 crop, the planting of which began in September, is tentatively forecast at about 4% above the 1948-49 harvest. An increase in the production of flue-cured and dark types is anticipated, while the production of Burley and native light types is expected to be about the same as in 1948-49.

TABLE 1. CROP ACREAGE

Crop	*Average 5 years ended* 1938-39	*Average 5 years ended* 1943-44	1944-45	1945-46	1946-47	1947-48	*1948-49
CEREALS:	'000 acs.	'000 acs.	'000 acs.	'000 acs.	'000 acs.	'000 acs.	'000 acs.
Wheat	12,980	11,018	8,463	11,425	13,180	13,880	12,971
Barley—2 row	490	546	500	593	663	745	n.a.
Barley—6 row	82	108	114	106	85	94	n.a.
Oats	1,569	1,555	2,034	1,949	1,728	2,105	n.a.
Maize	311	309	257	236	260	223	n.a.
Sorghum (grain)	n.a.	27	63	56	121	141	n.a.
Rice	23	29	25	28	32	26	33
HAY	3,104	2,503	2,409	2,757	2,006	1,970	n.a.
POTATOES	120	132	242	176	145	146	n.a.
VINEYARDS:							
Productive	113	123	124	123	124	123	n.a.
Unproductive	9	6	5	5	6	9	n.a.
OTHER CROPS:							
Sugar†	248	254	226	236	227	222	n.a.
Tobacco	10	8	5	4	4	4	n.a.
Flax	1	38	61	41	18	18	n.a.
Cotton‡	56	48	17	8	8	8	n.a.

*Preliminary—Subject to revision. †Area crushed. ‡Area harvested.

TABLE 2. CROP YIELDS

Commodity	*Unit*	*Average 5 years ending* 1938-39	*Average 5 years ending* 1943-44	1944-45	1945-46	1946-47	1947-48	* 1948-49
CEREALS (for grain):								
Wheat	m. bush.	154.3	145.0	52.9	142.4	117.3	220.1	189.8
Barley—2 row	,,	8.5	9.8	4.2	9.6	10.6	18.9	n.a.
Barley—6 row	,,	1.3	1.6	0.8	1.5	1.0	1.9	n.a.
Oats	,,	17.0	19.4	9.0	25.8	15.6	40.7	n.a.
Maize	,,	7.3	7.5	6.5	5.7	5.8	6.1	n.a.
Sorghum (grain)	,,	n.a.	0.5	1.2	1.0	1.9	3.8	n.a.
Rice	,,	2.3	2.7	1.7	2.7	3.0	2.7	2.6
HAY	m. tons	3.5	3.1	2.0	3.5	2.4	3.0	n.a.
VEGETABLES:								
Potatoes	'ooo tons	338	440	881	646	544	498	500
FRUIT (vine crops):								
Grapes:								
For drying	'ooo tons	289	357	264	288	299	322	n.a.
For table use	,,	14	15	16	15	15	15	n.a.
For wine	,,	105	103	77	143	166	171	n.a.
Total grapes	,,	408	475	358	446	436	508	n.a.
Wine made	m. gal.	17.9	17.3	14.4	25.9	33.2	34.2	n.a.
OTHER CROPS								
Peanuts	m. lb.	13.4	15.1	22.9	29.8	57.0	35.5	n.a.
Sugar (from cane)	'ooo tons	740	731	670	666	552	605	949
Tobacco (dried leaf)	m. lb.	5.0	5.4	2.8	2.5	4.0	2.5	2.3
Flax (straw)	'ooo tons	n.a.	39	28	31	21	27	17
Cotton (unginned)	m. lb.	18.5	13.8	8.5	1.8	3.0	2.1	n.a.

*Preliminary—Subject to revision.

Deciduous fruit in Argentina

The outlook, according to trade sources, for Argentine deciduous fruit for the 1949-50 season is generally fair, although the apple and pear crops may be somewhat below last year's large crops. Growing conditions have been generally favourable, except in the Rio Negro valley where frosts have occurred. The Rio Negro valley is Argentina's principal source of apple and pear production and, on the basis of preliminary reports, the 1949-50 apple crop is forecast at a 15% decrease and pears at 30% from the 1948-49 crop. The 1948-49 apple crop is now estimated at 9 million boxes, compared with 4.4 for the 1947-48 crop and 6.1 million for the five-year average 1940-44. Pears for 1948-49, estimated at 5 million boxes, are 51% above the 1947-48 crop of 3.3 and 6% below the five-year (1940-44) average of 5.3 million bushels.

Egypt encourages planting of short staple cotton

Egyptian cotton of the Karnak and Menoufi varieties will be restricted in 1950 to 727,000 acres or 249,000 acres below the 1949 acreage, under a decree issued by the government. The planting of other varieties will not be restricted. This action is apparently intended as a means of causing a shift to the cultivation of the shorter staple Ashmouni and Zagora without any significant change in the total cotton acreage. Stocks of the foregoing extra-long staple varieties comprised 62% of the total stocks on hand at the end of the past season and the area planted to these varieties in 1949 represented 56% of the total 1949 cotton acreage. Stocks of the shorter staples are very low and export demand for them is rising as a result of the devaluation of currencies in western Europe and the continued scarcity of dollar exchange.